

# SYNOPSIS OF THE TREMATODE FAMILY HETERO-PHYIDAE WITH DESCRIPTIONS OF A NEW GENUS AND FIVE NEW SPECIES.

---

By BRAYTON HOWARD RANSOM,

Assistant Custodian, Helminthological Collections, United States National Museum.

---

The family Heterophyidae is composed of a number of genera of small flukes, parasitic in the intestine of mammals and birds, usually fish eaters. The family is of considerable interest in human and veterinary medicine as several species are of more or less common occurrence in man, dog, or cat. The following genera may be recognized as belonging to this family: *Heterophyes* Cobbold, 1866; *Cryptocotyle* Lühe, 1899; *Centrocestus* Looss, 1899; *Ascocotyle* Looss, 1899; *Apophallus* Lühe, 1909; *Pygidiopsis* Looss, 1907; *Metagonimus* Katsurada, 1913; a heretofore undescribed genus proposed in the present paper; and, provisionally, *Paracoenogonimus* Katsurada, 1914, a very imperfectly known genus possibly identical with *Cryptocotyle*. The following generic names in this family either fall as synonyms or are not to be recognized at present because the species upon which they are based are considered to belong to some of the genera of prior date:

*Coenogonimus* Looss, 1899 (type *heterophyes*), and *Cotylogonimus* Lühe, 1899 (type *heterophyes*) are both synonyms of *Heterophyes*. *Tocotrema* Looss, 1899 (type *lingua*), and *Hallum* Wigdor, 1918 (type *caninum*), are congeneric with the earlier *Cryptocotyle* Lühe, 1899 (type *concava*). *Tocotrema* and *Cryptocotyle* are based on different type species, but the differences in these do not appear sufficient to justify their generic separation, while *Hallum caninum* appears to be specifically identical with *Cryptocotyle lingua*. *Loossia* Ciurea, 1915 (type *romanica*), and *Yokogawa* Leiper, 1913 (type *yokogawa*=*yokogawai*), give way to *Metagonimus* Katsurada, 1913, Leiper's genus being based on the same type as *Metagonimus* and *Loossia* clearly having the characters of *Metagonimus*.

The genus *Scaphanocephalus* Jägerskiöld, 1903 (type and only known species *expansus*), has been considered by some authorities

to belong with the genera listed above, but is quite different from them in respect to the size of the body, *S. expansus* measuring 5 mm. or more in length, all of the other known members of the family being flukes less than 2 mm. in length, or in a few instances slightly exceeding this size. Furthermore the testes of *S. expansus* are distinctly median in position, one directly behind the other, very deeply lobed; the ovary is also much lobed, and the uterus voluminous, in all of which characters it differs from the Heterophyidae. *Scaphanocephalus* on the other hand resembles some of the Heterophyidae in the possession of a genital sucker in close relation with the ventral sucker, and in the arrangement of the vitellaria, and like all of them lacks a cirrus pouch. The similarities of *Scaphanocephalus* to the Heterophyidae, however, do not appear sufficient to justify its inclusion in this family.

Specimens of flukes belonging to the Heterophyidae that have recently come to the writer's attention have been found to represent a number of species as follows: Two new species of *Ascocotyle* from the fox (*Vulpes lagopus*); a new species of *Apophallus* from a gull (*Larus delawarensis*); *Cryptocotyle lingua* from the harbor seal (*Phoca vitulina*), for comparison with which some of the type specimens of *Hallum caninum* from the dog (= *C. lingua*) have been available through the courtesy of Parke, Davis and Co.; and two new species representing a new genus—one from the cat, dog, and fox, and the other from the harbor seal.

#### Family HETEROPHYIDAE Odhner, 1914.

*Family diagnosis*.—Fascioloidea: Small and very small forms usually not over 2 mm. long, rarely slightly longer, not exceeding 5 mm. in length. Anterior portion of body in front of ventral sucker thinner, more slender and more movable than the posterior portion. Surface of body thickly covered with small thin backward projecting scales that become reduced posteriorly and may entirely disappear toward the posterior end of the body. Intestinal ceca simple tubular sacs, commonly extending nearly to the posterior end of the body, running parallel with the lateral borders and not far removed from them throughout most of their course. Genital pore in the immediate neighborhood of the ventral sucker. Genital sucker may be present. Ventral sucker usually median, but may be displaced to the right of the median line. No cirrus pouch. Vas deferens and vagina with a common opening. Testes oval, globular, or slightly lobed, near the posterior end of the body, side by side, or obliquely one in front of the other. Seminal vesicle well developed, U- or S-shaped, the vas deferens surrounded proximally with a mass of pros-

tatic cells, and extending from the anterior limb of the seminal vesicle to the genital opening. Ovary oval, globular, or slightly lobed, median, or usually on the right, rarely on the left, of the median line, anterior of the testes. Seminal receptacle and Laurer's canal present, near the ovary, usually in relation with its posterior border. Vitellaria, located mainly in the lateral fields in the posterior end of the body, may extend anteriorly to or a short distance beyond the level of the ventral sucker, and may enter the median field and approach or extend to the median line in this region. Uterus arranged usually in a few transverse loops, but sometimes with numerous loops, limited to the region in front of the testes and behind the genital pore, except occasionally one or more loops may be present in front of the latter. Eggs usually not very numerous, from 15 to 50 $\mu$  long, rarely (*Paracoenogonimus*) may exceed 100 $\mu$  in length. Adults parasitic in the intestine of mammals and birds.

*Type genus.*—*Heterophyes* Cobbold, 1866.

## KEY TO GENERA.

1. Eggs not over 50 $\mu$  long-----2.  
Eggs over 100 $\mu$  long-----*Paracoenogonimus*, p. 550.
2. Ventral sucker median-----3.  
Ventral sucker and genital pore displaced to right of median line-----*Metagonimus*, p. 538.
3. Genital sucker present-----4.  
Genital sucker absent-----5.
4. Genital sucker median, directly posterior of the more or less rudimentary ventral sucker-----*Cryptocotyle*, p. 543.  
Genital sucker at one side of or obliquely behind the well-developed ventral sucker-----*Heterophyes*, p. 530.
5. Prepharynx long, pharynx usually nearer to the bifurcation of the intestine than to the oral sucker-----6.  
Prepharynx short, pharynx much nearer to the oral sucker than to the bifurcation of the intestine-----8.
6. Oral cecum present-----*Ascocotyle*, p. 561.  
Oral cecum absent-----7.
7. Mouth surrounded by a crown of spines; vitellaria extend into the region in front of the ventral sucker-----*Centrocestus*, p. 559.  
Mouth not surrounded by a crown of spines; vitellaria limited to the region of the testes-----*Pygidiopsis*, p. 568.
8. Vitellaria commonly extend into the median field in front of ventral sucker, frequently meeting in the median line, with comparatively few lobules in the post-testicular region, these not crossing the median line, and not extending between the testes-----*Cotylophallus*, p. 554.  
Vitellaria usually strictly lateral in the anterior region, not extending inwards to the median line in front of the ventral sucker, but with numerous lobules behind, between and often dorsal and ventral of the testes-----*Apophallus*, p. 551.

Genus **HETEROPHYES** Cobbold, 1866.

*Generic diagnosis.*—Heterophyiidae: Cuticular scales rectangular, longer than broad, length about 5 to 7.5  $\mu$ . Prepharynx short, pharynx nearer to the oral sucker than to the bifurcation of the intestine. Intestinal ceca extend into the posterior portion of the body reaching the level of or extending behind the testes. Ventral sucker median near the middle of the body. Genital pore surrounded by a genital sucker located near the ventral sucker at one side or obliquely behind it. Genital sucker armed with a circlet of curved chitinous rodlets, 25 to 80 in number; circlet more or less discontinuous on the side of the genital sucker toward the ventral sucker; rodlets about 10 to 20  $\mu$  long, with about 5 minute pointed processes in a row along the convex side. Testes globular or oval, situated side by side near the posterior end of the body right and left of the median line. Seminal vesicle well developed, U-shaped, behind the genital sucker. Ovary globular or ovoid, situated in front of the testes, median, or on the right of the median line. Seminal receptacle between testes and ovary. Vitellaria in the lateral fields in the posterior end of the body near the dorsal surface, not extending forward much beyond the level of the anterior border of the ovary. Coils of uterus in the region between the testes and the ventral sucker, none in front of the latter.

*Type species.*—*Heterophyes aegyptiaca* Cobbold, 1866 (= *Distoma heterophyes* Siebold, 1852, renamed).

The flukes of the genus *Heterophyes* in all probability occur in their immature stages in fish, the adults having been found thus far only in fish-eating birds and mammals, including man, this opinion being based on the fact that related flukes in the family Heterophyiidae are known to have immature stages in fish.

It appears questionable whether all of the species of *Heterophyes* that have been described are really distinct, but the writer has followed Looss (1902*n*) in recognizing seven species. It seems not unlikely, however, that Looss has carried the process of separating species beyond the limits of practicability and it is doubtful whether some of the species described by him can readily be distinguished from others, at least in the case of individual specimens.

## KEY TO SPECIES.

- |                                                                                                                                                                        |                              |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----|
| 1. Length 3 mm. or more; vitellaria dorsally extending inwards nearly to the borders of the ovary—<br>Length not over 2 mm.; vitellaria limited to lateral fields..... | <i>Heterophyes persicus.</i> | 2. |
| 2. Length usually greater than 0.9 mm.; vitellaria with about 14 lobules in each lateral field extend as far forward as the level of the anterior                      |                              |    |

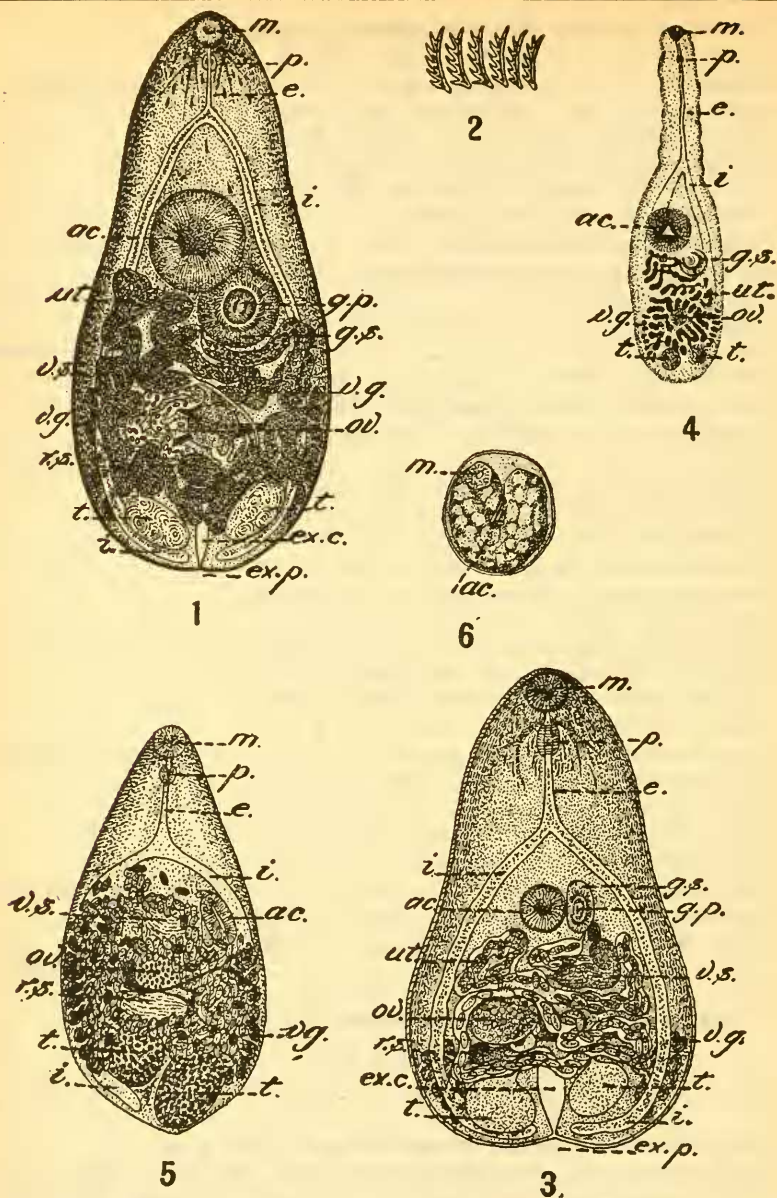


- border of the ovary; chitinous rodlets of genital sucker 70 to 80 in number; eggs about 30  $\mu$  long----- (heterophyes group)-- 3.
- Length usually less than 0.9 mm. may reach 1 mm.; vitellaria with 10 to 12 lobules in each lateral field extend only as far forward as the level of the posterior border of the ovary; chitinous rodlets of genital sucker 25 to 75 in number; eggs about 20  $\mu$  long----- (fraternus group)---- 4.
3. Length 1 to 1.7 mm.; eggs light brown; in man, dog, cat, and (?) fox----- *Heterophyes heterophyes*.  
Length 0.75 to 0.95 mm.; eggs bright yellow; in *Milvus aegyptius*----- *Heterophyes pallidus*.
4. Cuticular scales relatively long and narrow, very close together; chitinous rodlets of the genital sucker 65 to 75 in number; in *Pelecanus onocrotalus*----- *Heterophyes fraternus*.  
Cuticular scales relatively broad and coarse with rather wide intervals between them; chitinous rodlets of the genital sucker 25 to 35 in number----- 5.
5. Oral, ventral, and genital suckers not greatly different in size; intestinal ceca do not extend beyond the posterior borders of the testes----- 6.  
Ventral sucker much larger than the others, 2 to 3 times the diameter of the oral sucker; intestinal ceca reach posterior borders of testes, sometimes reaching excretory vesicle; eggs a deep dark brown in color; in dog and cat----- *Heterophyes dispar*.
6. Maximum length 0.46 mm.; free edges of cuticular scales ending in a number of very fine points; ventral sucker about 56  $\mu$  in diameter; color of eggs never darker than a light yellowish-brown; in *Pelecanus* and *Milvus*----- *Heterophyes inops*.  
Maximum length 0.5 to 0.9 mm.; ventral sucker 70 to 90  $\mu$  in diameter; color of eggs a bright brown; in cat and dog----- *Heterophyes aequalis*.

**HETEROPHYES HETEROPHYES (Siebold, 1852) Stiles and Hassall, 1900.**

Figs. 1, 2.

1852. *Distoma heterophyes* SIEBOLD 1852f, pp. 62-64, pl. 5, figs. 16-17 (in Homo; Egypt).
1855. *Distoma heterophyes hominis* DIESING, 1855e, p. 64.
1858. *Dicrocoelium heterophyes* (Siebold, 1852) WEINLAND, 1858a, p. 86.
1860. *Fasciola heterophyes* (Siebold, 1852) MOQUIN-TANDON, 1860a, p. 347.
1866. *Heterophyes aegyptiaca* COBBOLD, 1866a, p. 6 (type of *Heterophyes*; *Distoma heterophyes* renamed).
1890. *Mesogonimus heterophyes* (Siebold, 1852) RAILLIET, 1890w, p. 143.
1899. *Coenogonimus heterophyes* (Siebold, 1852) LOOSS, 1899b, pp. 585, 586, 619 (type of *Coenogonimus*).
1899. *Cotylagonimus heterophyes* (Siebold, 1852) LÜHE, 1899k, p. 539 (type of *Cotylagonimus*).
1900. *Heterophyes heterophyes* (Siebold, 1852) STILES and HASSALL, 1900a, p. 563.



FIGS. 1-6. 1.—*HETEROPHYES HETEROPHYES*. VENTRAL VIEW.  $\times 40$ . AFTER LOOSS, 1896. 2.—*HETEROPHYES HETEROPHYES*. CHITINOUS RODLETS OF GENITAL SUCKER.  $\times 525$ . AFTER LOOSS, 1896. 3.—*HETEROPHYES FRATERNUS*. VENTRAL VIEW.  $\times 123$ . AFTER LOOSS, 1896. 4.—*HETEROPHYES PERSICUS*. VENTRAL VIEW.  $\times 17$ . AFTER BRAUN, 1901. 5.—*METAGONIMUS YOKOGAWAI*. DORSAL VIEW OF ADULT FROM DOG.  $\times$  ABOUT 75. AFTER YOKOGAWA, 1913. 6.—*METAGONIMUS YOKOGAWAI*. ENCYSTED CERCARIA FROM SCALE OF FISH.  $\times$  ABOUT 100. AFTER YOKOGAWA, 1913. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE.]

#### EXPLANATION OF LETTERING USED IN ILLUSTRATIONS.

ac., ventral sucker. ap., appendix. e., esophagus. ex. c., excretory canal or vesicle. ex. p., excretory pore. g. c., opening of genital canals. g. p., genital pore. g. s., genital sucker. i., intestine. l., dorsal lip. l. b., lenticular body. m., mouth with oral sucker. o. c., oral cecum. ov., ovary. p., pharynx. p. p., prepharynx. pr., prostatic portion of vas deferens. r. s., seminal receptacle. t., testis. ut., uterus. v. d., vas deferens. v. e., vas efferens. v. g., vitellaria. v. s., seminal vesicle.

*Specific diagnosis.*—*Heterophyes*: Length, 1 to 1.3 mm.; breadth 0.6 mm. or over (specimens fixed in corrosive sublimate without shaking), or length 1.6 to 1.7 mm., width 0.3 to 0.4 mm. (specimens fixed in corrosive sublimate or alcohol, shaken during fixation). Cuticular scales relatively narrow, close together. Ventral sucker very muscular and thick-walled, two and one-fourth to two and three-fourths, genital sucker about one and one-half, times as large as the oral sucker. Average diameter of oral sucker, 90  $\mu$ ; of ventral sucker, 230  $\mu$ ; of genital sucker, 150  $\mu$ . Chitinous rodlets of genital sucker, 70 to 80 in number. Intestinal ceca slender, ends passing behind the testes and terminating near the excretory vesicle. Vitellaria consisting of about 14 lobules in each lateral field extend forward to about the level of the anterior border of the ovary. Lateral ends of the vitellaria viewed from the ventral side visible beyond the intestinal ceca, and some of the lobules often appear to curve around them toward the ventral side. Eggs light brown; about 30  $\mu$  by 17  $\mu$ .

*Hosts.*—Man; dog; cat; (?) fox.

*Location.*—Small intestine and cecum.

*Localities collected.*—Egypt, Japan, China.

According to Looss (1902*n*) all the specimens of *Heterophyes* from man examined by him belong to this species, also it is the usual species of *Heterophyes* found in the dog and occurs in this host in very large numbers, while in the cat it rarely occurs and usually in small numbers. As to the occurrence of *H. heterophyes* in the fox he is uncertain. Specimens of flukes collected from a fox and determined to be *Coenogonimus heterophyes* by Looss (1899*b*) were afterwards lost, and it is not possible to affirm whether or not they should be placed in *H. heterophyes sensu stricto*. Looss (1902*n*) recognizes a so-called *sentus*-form of *H. heterophyes* which is relatively rare in the dog, the cat apparently being the usual host, in several cases hundreds of flukes all belonging to this form being present. The largest well-stretched individuals of this form are 1.4 mm. long, 0.4 mm. wide; usual length 0.9 to 1.1 mm., breadth 0.3 to 0.5 mm. Ventral sucker about twice as large as the oral sucker, in young individuals somewhat less, in old individuals somewhat more, than twice as large. Genital sucker about equal in size to the ventral sucker, only in old individuals about one-fifth smaller. Average diameter of oral sucker 73  $\mu$ , of ventral sucker 146  $\mu$ , of genital sucker 112  $\mu$ . Eggs bright yellowish brown in color, brighter than those of *H. heterophyes*.

#### HETEROPHYES PALLIDUS Looss, 1902.

1902. *Heterophyes pallidus* Looss, 1902 *n*, pp. 889–890 (in *Milvus aegyptius*; Egypt).

*Specific diagnosis.*—*Heterophyes*: Maximum length of extended individuals 0.95 mm., breadth 0.38 mm.; average length of greatly

contracted individuals 0.75 to 0.8 mm., breadth 0.4 to 0.5 mm. Cuticular scales relatively narrow, close together. Ventral sucker always twice or more than twice (two to two and one-fourth times) the size of the oral sucker. Genital sucker about two-thirds the diameter of the ventral sucker. Average diameter of oral sucker, 62  $\mu$ ; of ventral sucker, 150  $\mu$ ; of genital sucker, 104  $\mu$ . Chitinous rodlets of genital sucker, 70 to 80 in number. Vitellaria, consisting of about 14 lobules in each lateral field, extend forward to about the level of the anterior border of the ovary. Eggs bright yellow in color, about 30 by 17  $\mu$ .

*Host*.—*Milvus aegyptius* (= *M. parasiticus*).

*Location*.—Small intestine.

*Locality collected*.—Egypt.

This species formerly included in *H. heterophyes* was separated from it by Looss (1902*n*) on account of certain differences in the relative dimensions of the suckers, and the color of the eggs.

**HETEROPHYES FRATERNUS (Looss, 1894) Looss, 1902.**

FIG. 3.

1894. *Distomum fraternum* Looss, 1894*d*, pp. 42–48, pl. 2, figs. 13–15 (in *Pelecanus onocrotalus*; Egypt).

1899. *Coenogonimus fraternus* (Looss, 1894) Looss 1899*b*, pp. 585, 700–701.

1901. *Cotylogonimus fraternus* (Looss, 1894) BRAUN, 1901*e*, p. 337.

1902. *Heterophyes fraternus* (Looss, 1894) Looss 1902*m*, pp. 785, 808, 809, 838, 854.

*Specific diagnosis*.—*Heterophyes*: Largest most extended individuals nearly 0.6 mm. long, usually 0.4 to 0.5 mm. and about 0.3 mm. wide. Cuticular scales relatively long and narrow, very close together. Ventral sucker and genital sucker almost equal in size in young individuals, and somewhat larger than the oral sucker, in older individuals the ventral sucker being larger than the genital sucker. Average diameter of oral sucker, 50  $\mu$ ; of ventral sucker, 70  $\mu$ ; of genital sucker, 60  $\mu$ . Chitinous rodlets of the genital sucker 65 to 75 in number, the circlet presenting the appearance of a fine comb or brush in certain stages of contraction of the sucker. Intestinal ceca always extend behind the testes and terminate near the wall of the excretory vesicle. Vitellaria consisting of 10 to 12 lobules in each lateral field extending forward only as far as the level of the posterior border of the ovary. Eggs about 20 by 10  $\mu$  in diameter, shell about 1  $\mu$  thick; color never darker than a light yellowish-brown.

*Host*.—*Pelecanus onocrotalus*.

*Location*.—Small intestine.

*Locality collected*.—Egypt.



## HETEROPHYES INOPS Looss, 1902.

1902. *Heterophyes inops* Looss 1902n, pp. 887-888 (in *Pelecanus onocrotalus*; Egypt).

*Specific diagnosis.*—*Heterophyes*: Largest mature individuals 0.46 mm. long. Cuticular scales relatively short and broad with their free edges terminating in a number of very fine points; arranged, especially on the ventral surface of the body, with rather wide intervals between them. Ventral sucker a little larger, the genital sucker in its retracted condition a little smaller, than the oral sucker. Oral sucker, 46  $\mu$ ; ventral sucker, 56  $\mu$ ; genital sucker, 36  $\mu$  in average diameter. Chitinous rodlets of the genital sucker 25 to 35 in number, rather widely separated from one another. Intestinal ceca usually rather wide, normally extend only as far as the anterior borders of the testes, but may reach nearly to their posterior borders, never beyond them. Vitellaria consisting of 10 to 12 lobules in each lateral field extending forward only as far as the level of the posterior border of the ovary, and limited to the dorsal portion of the body near the surface. Eggs about 20 by 10  $\mu$  in diameter, shell about 1  $\mu$  thick; color never darker than a light yellowish-brown.

*Hosts.*—*Pelecanus onocrotalus*; *Milvus aegyptius* (= *M. parasiticus*).

*Location.*—Small intestine.

*Locality collected.*—Egypt.

This species originally included in *H. fraternus* was separated from it by Looss (1902n) because of slight differences in the cuticular scales, extent of the intestinal ceca, relative dimensions of the suckers, and number of chitinous rodlets in the genital sucker.

## HETEROPHYES AEQUALIS Looss, 1902.

1902. *Heterophyes aequalis* Looss, 1902n, p. 888 (in cat and dog; Egypt).

*Specific diagnosis.*—*Heterophyes*: Largest individuals 0.9 mm. long. Average size 0.5 to 0.7 mm. long by 0.3 to 0.4 mm. wide. Cuticular scales relatively broad and coarse, rather widely separated. Oral sucker and genital sucker almost equal in size, diameter varying in mature individuals between 50 and 60  $\mu$ . Ventral sucker somewhat larger, varying between 70 and 90  $\mu$  in diameter according to age. Chitinous rodlets of genital sucker 25 to 35 in number, rather widely separated from one another. Intestinal ceca end between the levels of the anterior and posterior borders of the testes, frequently at somewhat different levels on the two sides. Vitellaria only near the dorsal surface of the body, lobules very compact, 10 to 12 in each lateral field, extending forward only as far as the level of the posterior border of the ovary. Eggs about 20 by 10  $\mu$

in diameter, with shell about  $1\ \mu$  thick; their color in anterior portions of uterus a bright brown, and even in very young individuals with a few eggs, the color is deeper than in *H. inops*.

*Hosts*.—Cat (apparently the usual host); dog (common in this host, but in small numbers).

*Location*.—Small intestine.

*Locality collected*.—Egypt.

This species like *H. inops* was formerly included in *H. fraternus*, but separated from it by Looss (1902*n*) because of differences in the cuticular scales, extent of the intestinal ceca, relative dimensions of the suckers, and number of chitinous rodlets in the genital sucker. It is a somewhat larger species than *H. inops*; the ventral sucker is considerably larger, and the eggs are deeper in color.

#### HETEROPHYES DISPAR Looss, 1902.

1902. *Heterophyes dispar* Looss, 1902*n*, pp. 888-889, 890, 891 (in dog and cat; Egypt).

*Specific diagnosis*.—*Heterophyes*: Average length, 0.8 to 0.9 mm., may reach 1 mm. in old fully grown individuals; breadth, 0.3 to 0.4 mm. Cuticular scales very large, and separated from one another by relatively wide intervals even as far forward as the middle of the body. Oral sucker and genital sucker almost equal in size. Ventral sucker very large; in young individuals about twice, in old individuals almost three times, as large as the oral sucker. Average diameter of oral sucker,  $68\ \mu$ ; of ventral sucker,  $168\ \mu$  (transverse) and  $146\ \mu$  (longitudinal); of genital sucker,  $72\ \mu$ . Chitinous rodlets of genital sucker about 30 in number, separated by rather wide intervals. Intestinal ceca reach the posterior borders of the testes and may extend as far as the wall of the excretory vesicle. Vitellaria consisting of 10 to 12 lobules in each lateral field, extending forward only as far as the level of the posterior border of the ovary. Eggs about  $20\ \mu$  by  $10\ \mu$  in diameter; shell about  $1\ \mu$  thick; color of mature eggs a deep dark brown.

*Hosts*.—Dog (of common occurrence in this host); cat (occasional host; occurs in small numbers in this host).

*Location*.—Small intestine.

*Locality collected*.—Egypt.

*Heterophyes dispar* was formerly included in *H. fraternus*, but Looss (1902*n*) separated it from this species because of its larger size, coarser cuticular scales, its very large ventral sucker, small number of chitinous rodlets in the genital sucker, and much browner color of the eggs. Looss (1902*n*) recognizes a *limatus*-form of *H. dispar* found once in the intestine of a cat in Egypt, 23 specimens being collected. This form is more slender than the usual specimens of *H. dispar*, measuring 0.85 mm. long by 0.2 to 0.25 mm. wide. The

ventral sucker, instead of two to three times as large as the oral sucker, is only one-half to three-fourths larger. Average diameter of oral sucker, 50  $\mu$ ; ventral sucker, 80  $\mu$ ; genital sucker, 46  $\mu$ . Eggs dark brown, but somewhat lighter than those of *H. dispar*.

**HETEROPHYES PERSICUS (Braun, 1901) Looss, 1902.**

Fig. 4.

1901. *Cotylogonimus persicus* BRAUN, 1901c, pp. 334-338, pl. 20, fig. 13 (in Persian wolf; Germany).

1902. *Heterophyes persicus* (Braun, 1901) Looss, 1902m, pp. 782, 785.

*Specific diagnosis.*—*Heterophyes*: Length, 3 to 4 mm.; maximum width, 0.8 to 0.9 mm. Oral sucker globular, 104  $\mu$  in diameter, or transversely elongated, 73 by 104  $\mu$ . Prepharynx rather long but shorter than the esophagus. Pharynx almost globular, 62  $\mu$  long by 53  $\mu$  wide. Bifurcation of intestine in front of the ventral sucker a distance about equal to its diameter. Intestinal ceca end near the excretory vesicle. Ventral sucker near the boundary between the middle and posterior thirds of the body, 375 to 416  $\mu$  in diameter. Genital sucker, about 250  $\mu$  in diameter, on the left side of and obliquely behind the ventral sucker, usually circular, occasionally somewhat broader than long. Crown of chitinous rodlets interrupted on the side of the genital sucker toward the ventral sucker. Rodlets slightly curved, supplied with 4 to 6 small pointed processes directed toward the free end of the rodlet, this free end being turned toward the center of the sucker. The pointed processes of the rodlet at the same time, however, lie in a plane perpendicular to the surface of the sucker. Number of rodlets 62 to 70; length nearly uniform, 9 to 10.4  $\mu$ ; those near the interrupted portion of the crown always a little shorter than the others. Testes elliptical, left testis sometimes somewhat more anterior than right testis, about 200 by 160  $\mu$  in diameter. Ovary, 145  $\mu$  in diameter, in median line in front of testes. Seminal receptacle not apparent, coils of uterus filling space between testes and ovary. Vitellaria only weakly developed; as viewed from ventral surface appear to consist of 6 to 9 lobules on each side, extending from the level of the anterior border of the ovary to the level of the middle of the testes. As viewed from the dorsal surface the vitellaria are seen to consist of about 12 to 18 lobules on each side, since they push inwards between the coils of the uterus almost to the ovary. Most of the space between the testes and ventral sucker occupied by the uterus. Behind the ventral sucker a small globular organ belonging to the male copulatory apparatus. Mature eggs thick-shelled, dark brown, 22.8  $\mu$  long, 14  $\mu$  wide.

*Host.*—Persian wolf.

*Location.*—Intestine.

*Locality collected.*—Germany (Berlin Zoological Garden).

## Genus METAGONIMUS Katsurada, 1913.

*Generic diagnosis.*—Heterophyidae: Prepharynx short; pharynx much nearer to the oral sucker than to the bifurcation of the intestine. Intestinal ceca extend into the posterior portion of the body, reaching the level of the posterior testis or extending behind it. Ventral sucker near the right side of the body near the right intestinal cecum, near or in front of the middle of the body. Genital sinus immediately in front of the ventral sucker and opening to the exterior in common with the latter through the genital pore. Testes globular or oval, in posterior end of body, right testis obliquely behind the left. Seminal vesicle well developed, retort-shaped, located to the left of and behind the ventral sucker. Ovary oval or globular, median in location, a short distance in front of the anterior testis. Seminal receptacle behind or to the right of the ovary. Vitellaria consist of a few rather large lobules located in the lateral fields and dorsal of the intestinal ceca and extending from the level of the anterior border of the ovary into the post-testicular region, but not crossing the excretory vesicle. Uterus with rather numerous coils occupies most of the posterior portion of the body between the testes and the level of the genital sucker. Eggs about 30  $\mu$  in length.

*Type species.*—*Metagonimus yokogawai* (Katsurada, ?1912) Katsurada, 1913.

## METAGONIMUS YOKOGAWAI (Katsurada, ? 1912) Katsurada, 1913.

Figs. 5–10.

- ?1912. *Heterophyes yokogawai* KATSURADA, ?1912 (adults in man, dog, and other mammals; immature stage in *PlecoGLOSSUS altivelis*; Formosa).
- 1913. *Metagonimus yokogawai* (Katsurada) KATSURADA, 1913 in YOKOGAWA, 1913 (May), pp. 49–77, 1 pl., figs. 1–15; summary in German, pp. 3–4.
- 1913. *Yokogawa yokogawa* (Katsurada, ?1912) LEIPER, 1913 (July), pp. 282–285, fig. 31 (type of *Yokogawa*; misprint for *Yokogawa yokogawai*).
- 1913. *Tocotrema yokogawa* (Katsurada, ?1912) LEIPER, 1913, p. 282 (misprint for *Tocotrema yokogawai*).
- 1913. *Metagonimus ovatus* YOKOGAWA, 1913, pp. 45–49, 1 pl., figs. 1–2 (?host; ?Japan).
- 1915. *Loossia romanica* CIUREA, 1915, pp. 446–453, pl. 1, figs. 1–3 (type of *Loossia*; in dog; Roumania).
- 1915. *Loossia parva* CIUREA, 1915, pp. 453–454, pl. 1, fig. 4 (in cat; Roumania).
- 1915. *Loossia dobrogiensis* CIUREA, 1915, p. 454 (in *Pelecanus onocrotalus*; Roumania).



*Specific diagnosis.*—*Metagonimus*: Length from a minimum of about 0.35 mm. up to a maximum of 2.5 mm., commonly 1 to 1.5 mm.; width, 0.24 to 0.73 mm. Cuticular scales, 9 to 10  $\mu$  long by about 5  $\mu$  wide. Oral sucker, 48 to 110  $\mu$  in diameter. Prepharynx may reach a length of 74  $\mu$  in the extended condition. Pharynx 29 to 63  $\mu$  long by 22 to 52  $\mu$  wide. Esophagus considerably longer than the prepharynx, may reach a length of 143  $\mu$ . Ventral sucker placed with its long axis diagonal with reference to the longitudinal axis of the body, its posterior end deflected to the right, 66 to 165  $\mu$  long by 55 to 114  $\mu$  wide. In relation with the genital sinus and ventral sucker a crescentic muscular body or appendix somewhat similar to the genital papilla in the genital sinus of *Cryptocotyle*. Testes reach a maximum diameter of about 280  $\mu$ . Ovary 67 to 145  $\mu$  long by 67 to 165  $\mu$  wide. Seminal receptacle commonly somewhat larger than the ovary. Vitellaria consist of about 10 lobules in each lateral field. Eggs 27.5 to 30  $\mu$  long by 15 to 17  $\mu$  wide, yellowish-red, yellowish-brown, or dark brown in color.

*Immature stage* (encysted cercaria).—On the ovary in oval cysts 140 to 160  $\mu$  long by 100 to 120  $\mu$  wide; on the scales and in muscles in usually round cysts 126 to 160  $\mu$  in diameter; on the fins and tail in round cysts enclosed in an outer membrane 40  $\mu$  or more in thickness; diameter over all, about 224  $\mu$ . Larva covered by small spines; suckers and intestine visible; excretory vesicle very prominent. Removed from capsule, larva measures in fresh condition 0.4 to 0.47 mm. long. Ventral sucker smaller than oral sucker. Intestinal ceca extend to the posterior end of the body. Excretory vesicle containing numerous highly refractile granules occupies most of the space between the intestinal ceca. Genital organs undeveloped. When ingested by final host immature fluke develops to adult containing eggs in 4 to 5 days, oviposition beginning in 7 to 10 days after ingestion.

*Hosts.*—Man; dog; cat; pig; pelican (*Pelecanus onocrotalus*); mouse (experimental infections). Immature stages encysted in fishes (*Plecoglossus altivelis*; *Carassius auratus*; *Leuciscus hachuensis*; *Scardinius erythrophthalmus*; *Abramis brama*; *Esox lucius*; *Carassius carassius*; *Aspius aspius*; *Idus idus*; *Blicca björkna*).

*Location.*—Small intestine. (Immature stages in fresh-water fishes encysted in ovary, muscles, fins, tails, or on the scales.)

*Localities collected.*—Formosa; Japan; Korea; Roumania.

Leiper (1913) proposed the genus *Yokogawa* with Katsurada's species as type, but as his paper was not published until July the name is antedated by *Metagonimus*, which was published in May of the same year.

In addition to his papers on *M. yokogawai*, Yokogawa (1913, pp. 45-49, 3-4) has published another paper on *Metagonimus*, in which

he describes a second species, *M. ovatus* (fig. 7). This paper is in Japanese. A brief summary is given in German, in which it appears that *M. ovatus* differs from *M. yokogawai* in being oval in shape and smaller in size. These differences, in the opinion of the present writer, are insufficient to justify the separation of the two forms, and *M. ovatus* accordingly has been listed among the synonyms of *M. yokogawai*. It is not evident from what species of host animal *M. ovatus* was obtained. Presumably it was found in Japan.

Ciurea (1915) without knowledge of Yokogawa's work described the genus *Loossia* with three species based on flukes occurring in Rou-

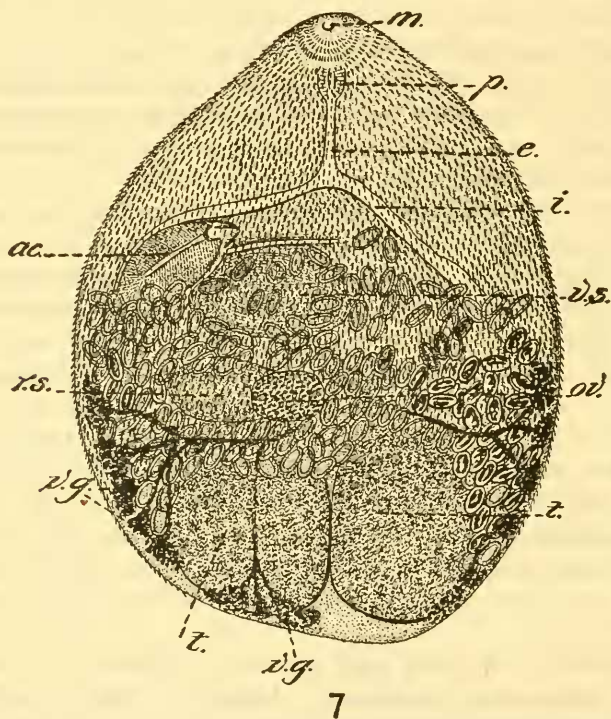


FIG. 7.—METAGONIMUS OVATUS (= *M. YOKOGAWAI*). VENTRAL VIEW.  $\times$  ?. AFTER YOKOGAWA, 1913.  
[FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

mania. In a later article (1915) he called attention to the close resemblance between *Loossia* and *Metagonimus* and the possible identity of the two genera, although he considered it questionable whether both should not be recognized in view of certain discrepancies between Yokogawa's description and his own findings. In the present writer's opinion, however, the two genera are not distinguishable, and furthermore it does not appear that in practice the various species that have been described could be distinguished from one another.

As described by Yokogawa (1913) the adult *M. yokogawai* in the living condition measured 1 to 1.5, seldom 2.5, mm. long by 0.425 to 0.73 mm. wide. Oral sucker, 77 to 86.4  $\mu$  in diameter. Pharynx, 50.4 to 52.4  $\mu$  long by 45 to 52  $\mu$  wide. Ventral sucker, 120 to 136.8  $\mu$  long by 84.8 to 108  $\mu$  wide. Ovary, 120 to 132  $\mu$  in diameter. Testes, 210 to 280  $\mu$  in transverse diameter. Preserved specimens measured 0.56 to 0.982 mm. long by 0.35 to 0.526 mm. wide. Oral sucker, 48 to 62.4  $\mu$  in diameter. Pharynx, 28.8 to 36  $\mu$  long by 24 to 35.5  $\mu$  wide. Ventral sucker, 88.8 to 129.2  $\mu$  long by 55.2 to 60  $\mu$  wide. Ovary, 67.2 to 96  $\mu$  in diameter. Testes, 120 to 156  $\mu$  in transverse diameter. The cuticular scales measured 9.6 to 10  $\mu$  long in fully developed adults, and were described as nail-shaped. The eggs measured 27.5 to 30  $\mu$  long by 15 to 16.8  $\mu$  wide; color yellowish-brown.

Yokogawa has found *Metagonimus yokogawai* occurring in the adult stage in man, dog, and cat, and has reared the worms to sexual maturity in dogs and mice fed with the cercariae. The usual host of the cercaria in Formosa is a trout (*Plecoglossus altivelis*), a fish commonly eaten raw in that country, but the cercaria has also been found encysted in *Carassius auratus* and *Leuciscus hachuensis* by Katsurada in Japan, as well as in *Plecoglossus*. According to Katsurada the cercaria is common in fishes in Korea, and he has observed the eggs of *M. yokogawai* in the feces of Koreans.

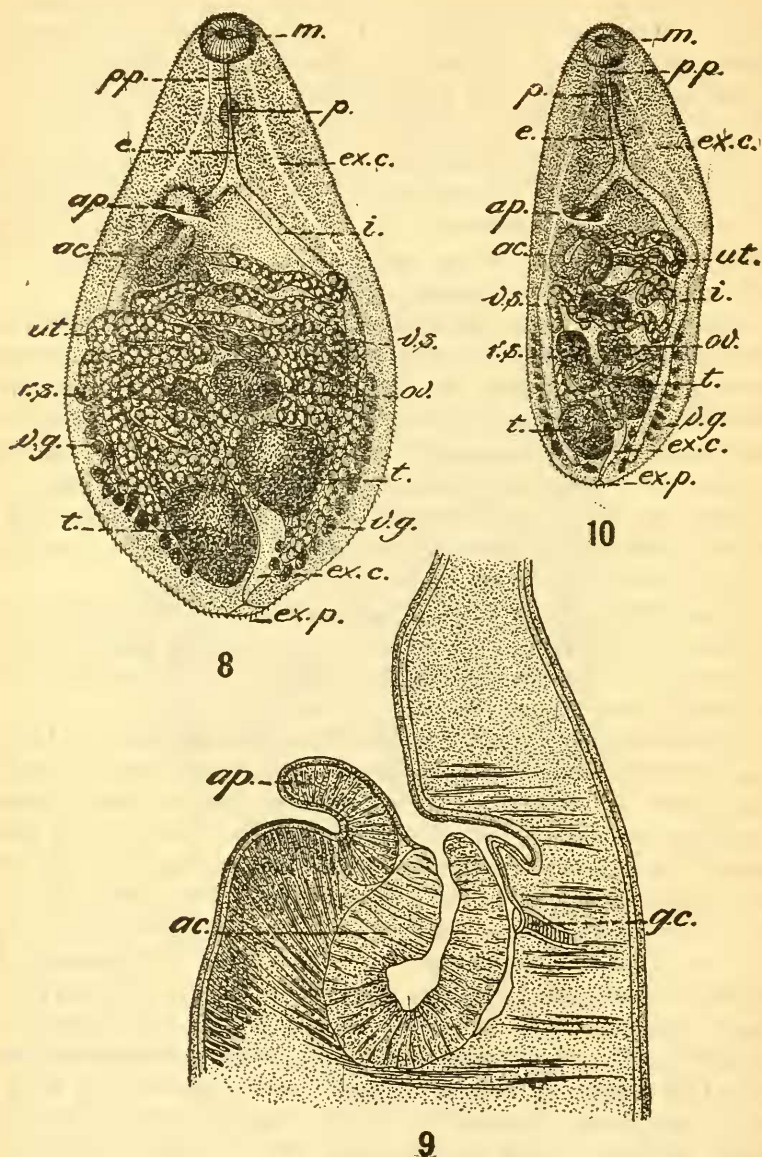
Ciurea (1915, pp. 445-458) has described *Loossia romanica* from the dog, *L. parva* from the cat, and *L. dobrogensis* from the pelican in Roumania. The morphological differences in these three forms are chiefly those of size and color of the eggs.

*Loossia romanica* (figs. 8, 9) from the dog measures 0.6 to 1.56 mm. long, 0.4 to 0.54 mm. wide. Cuticular scales rectangular, 9  $\mu$  long, 5  $\mu$  wide, posterior free edge somewhat rounded, very minutely dentated; in anterior portion of body 3  $\mu$  apart; behind genital sinus become gradually smaller and less numerous toward the posterior end of the body. Oral sucker, 81 to 110  $\mu$  in diameter. Prepharynx 22 to 74  $\mu$  long according to state of contraction. Pharynx, 50 to 63  $\mu$  long by 30 to 44  $\mu$  broad. Esophagus, 86 to 143  $\mu$  long. Bifurcation of intestine about one-third the body length from the anterior end of body. Right intestinal cecum ends between the levels of the anterior and posterior border of the right testis; left cecum reaches nearly to the wall of the excretory vesicle. Ventral sucker, 96 to 165  $\mu$  long and 96 to 114  $\mu$  wide. Testes, 149 to 224  $\mu$  long by 121 to 187  $\mu$  wide. Ovary, 83 to 145  $\mu$  long by 88 to 165  $\mu$  wide. Eggs average 28  $\mu$  by 17  $\mu$  in diameter; reddish brown in color.

*Loossia parva* (fig. 10) from the cat measures 0.36 to 0.78 mm. long, 0.24 to 0.38 mm. wide. Cuticular scales relatively short and narrow, separated by wide intervals, especially on ventral surface of body. Oral sucker, 59 to 94  $\mu$  in diameter. Pharynx, 40 to 52  $\mu$  long, 22 to



35  $\mu$  wide. Intestinal ceca, of equal length, extend beyond posterior border of testes. Ventral sucker 66 to 132  $\mu$  long by 66 to 79  $\mu$  wide. Eggs yellowish-red in color.



FIGS. 8-10. 8.—*LOOSSIA ROMANICA* (=METAGONIMUS YOKOGAWAI). VENTRAL VIEW.  $\times 87$ . AFTER CIUREA, 1915. 9.—*LOOSSIA ROMANICA* (=METAGONIMUS YOKOGAWAI). SAGITTAL SECTION THROUGH REGION OF VENTRAL SUCKER.  $\times 235$ . AFTER CIUREA, 1915. 10.—*LOOSSIA PARVA* (=METAGONIMUS YOKOGAWAI). VENTRAL VIEW.  $\times 87$ . AFTER CIUREA, 1915. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

*Loossia dobrogiensis* from the pelican measures 0.65 to 1.01 mm. long, 0.31 to 0.53 mm. wide. Cuticular scales broad, very close to-



gether. Oral sucker, 70 to 90  $\mu$  in diameter. Pharynx, 44 to 52  $\mu$  long by 31 to 41  $\mu$  wide. Intestinal ceca extend beyond posterior border of testes. Ventral sucker, 110 to 147  $\mu$  long by 77 to 107  $\mu$  wide. Eggs deep dark brown in color.

Ciurea fed dogs, cats, and pigs on various kinds of Roumanian fishes, maintaining appropriate controls, with the result that *Loossia romanica* developed in the dog, cat, and pig fed upon fish of the following species: *Esox lucius*, *Scardinius erythrophthalmus*, *Abramis brama*, *Carassius carassius*, *Aspius aspius*, *Idus idus*, and *Blicca björkna*. *Loossia parva* developed in a cat fed upon *Esox lucius*. He considers *Blicca björkna* and *Aspius aspius* to be the principal intermediate hosts of *L. romanica*.

#### Genus CRYPTOCTYLE Lühe, 1899.

*Generic diagnosis*.—Heterophyidae: Prepharynx present but usually considerably shorter than esophagus. Esophagus short; bifurcation of intestine nearer to the oral sucker than to the ventral sucker. Intestinal ceca extend into the posterior end of the body, terminating behind the level of the testes. Ventral sucker, median, more or less rudimentary, in relation with the anterior portion of the genital sucker, and communicating with the exterior through the genital pore, which is located in the center of the genital sucker. Genital sucker well developed, situated in the median line about midway of the body. The genital sinus which opens to the exterior through the genital pore, and into which the vas deferens and vagina open, is posterior of the ventral sucker. A genital papilla projects into the genital sinus and is protrusible through the genital pore. Prostatic portion of vas deferens well developed, dorsal of and behind the genital sucker. Seminal vesicle well developed, situated behind the genital sucker, arranged in transverse loops, dorsal of the coils of the uterus. Testes near posterior end of body, irregularly oval or globular, and usually slightly lobed, side by side, or right testis obliquely behind the left. Seminal receptacle in front of and to the right of the left testis. Ovary irregularly oval, or usually lobed, commonly like a clover leaf, situated on the right side of the median line in front of the seminal receptacle. Vitellaria extend across body in front of genital pore, on the dorsal side of the branches of the intestine and often meet in the median line. Anterior limits of the vitellaria usually at a considerable distance posterior of the bifurcation of the intestine; posteriorly they extend behind the testes and usually cross the median line. Transverse vitelline ducts located in the neighborhood of the boundary between the ovarian and testicular zones. Uterus disposed in a few loops in the median line; none in front of the genital pore.

*Type species*.—*Cryptocotyle concava* (Creplin 1825).

## KEY TO SPECIES.

1. Genital sucker over 100  $\mu$  in diameter.....2.  
 Genital sucker less than 100  $\mu$  in diameter.....*Cryptocotyle jejuna*.
2. Breadth of body usually more than half the length;  
 testes side by side; eggs 34 to 38  $\mu$  long.....*Cryptocotyle concava*.  
 Breadth of body usually less than half the length; testes  
 usually obliquely one in front of other; eggs 40 to 50  $\mu$   
 long.....*Cryptocotyle lingua*.

## CRYPTOCOTYLE CONCAVA (Creplin, 1825) Fiscoeder, 1903.

Fig. 11.

1825. *Distoma concavum* CREPLIN, 1825a, pp. 45-47, 83, figs. 7-8 (in *Colymbus rufogularis*).  
 1892. *Distoma (Dicrocoelium) concavum* (Creplin, 1825) STOSSICH, 1892c, pp. 158-159, 188, 189.  
 1899. *Cotylogonimus (Cryptocotyle) concavum* (Creplin, 1825) LÜHE, 1899k, p. 539 (type of *Cryptocotyle*).  
 1899. *Tocotrema concavum* (Creplin, 1825) LOOSS, 1899b, p. 586.  
 1903. *Cryptocotyle concava* (Creplin, 1825) FISCHÖEDER, 1903h, p. 548.

*Specific diagnosis*.—*Cryptocotyle*: Maximum length about 1 mm., width up to 0.85 mm. Oral sucker, 60 to 87  $\mu$  in diameter. Genital sucker, 150 to 300  $\mu$  in diameter. Pharynx, about 60  $\mu$  long by 50  $\mu$  broad. Esophagus about 95  $\mu$  long. Testes slightly lobed, transversely elongated, side by side, right and left; may attain 300  $\mu$  in major diameter. Ovary transversely elongated, slightly lobed. Eggs 34 to 38  $\mu$  long by 16 to 20  $\mu$  wide.

*Hosts*.—*Urinator stellatus*, *Colymbus cristatus*, *Colymbus nigricollis*, *Mergus merganser*, *Mergus serrata*, *Anas hornshuchii*, *Nyroca marila*, *Nyroca clangula*, *Nyroca hyemalis*, *Oidemia fusca*, *Alca torda*, *Colymbus rufogularis*, *Harelda glacialis*, *Larus glaucus*, *Phalacrocorax graculus*.

*Location*.—Small and large intestines.

*Localities collected*.—Europe.

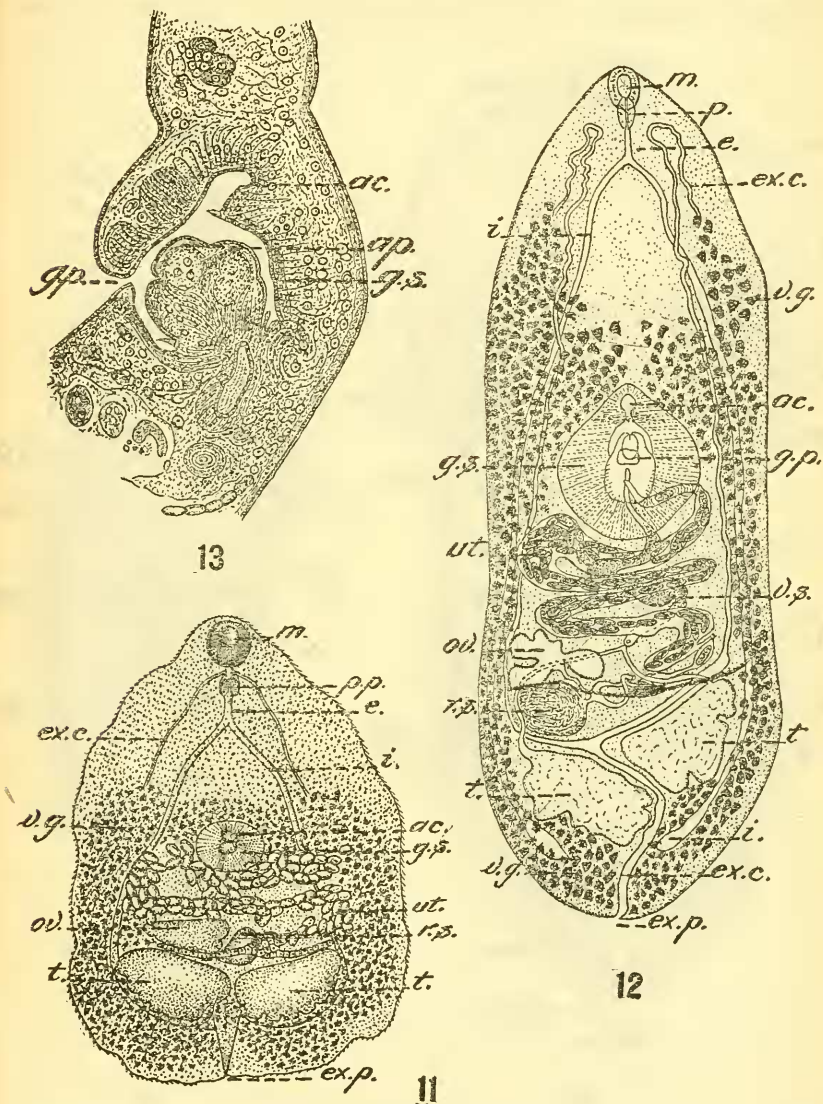
## CRYPTOCOTYLE LINGUA (Creplin, 1825) Fiscoeder, 1903.

Figs. 12-15.

1825. *Distomum lingua* CREPLIN, 1825a, pp. 47-48 (in *Larus marinus* v. *maximus*; apparently Europe).  
 1899. *Tocotrema lingua* (Creplin, 1825) LOOSS, 1899b, p. 586 (type of *Tocotrema*).  
 1903. *Cryptocotyle lingua* (Creplin, 1825) FISCHÖEDER, 1903h, p. 548.  
 1905. *Dermocystis ctenolabri* STAFFORD, 1905a, p. 682 (in gills and skin of *Ctenolabrus adspersus*).  
 1918. *Hallum caninum* WIGDOR, 1918, pp. 254-257, figs. 1-4 (type of *Hallum*; in dog, Detroit, Mich.).

*Specific diagnosis*.—*Cryptocotyle*: Length, 0.55 mm. to 2 mm., or slightly more than 2 mm. in extended specimens: usually (Jäger-

skiöld, 1899a) 1.5 to 1.7 mm. Width, 0.2 to 0.9 mm., usually (Jägerskiöld) about 0.4 mm. Cutaneous scales about  $1\ \mu$  wide by 2 to  $4\ \mu$  long. Oral sucker, 66 to  $110\ \mu$  in diameter (about  $80\ \mu$  accord-

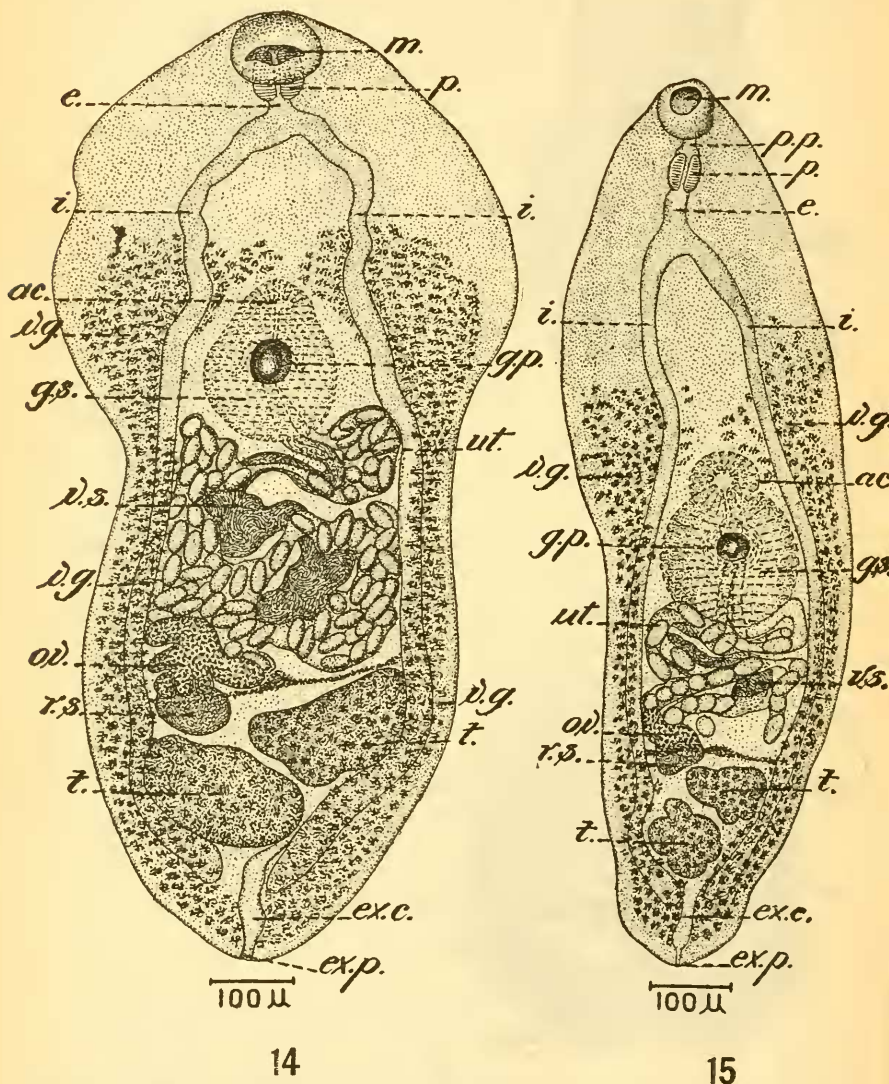


FIGS. 11-13. 11.—*CRYPTOCOTYLE CONCAVA*. VENTRAL VIEW.  $\times 71$ . AFTER NICOLL, 1909. 12.—*CRYPTOCOTYLE LINGUA*. VENTRAL VIEW.  $\times 75$ . AFTER JÄGERSKIÖLD, 1899. 13.—*CRYPTOCOTYLE LINGUA*. SAGITTAL SECTION THROUGH REGION OF GENITAL PORE.  $\times 214$ . AFTER JÄGERSKIÖLD, 1899. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

ing to Jägerskiöld, 75 to  $85\ \mu$  according to Nicoll, 1907f, 70 to  $90\ \mu$  according to Linton, 1915, 66 to  $104\ \mu$  according to Wigdor, 1918). Prepharynx shorter in length than the pharynx. Pharynx, 30 to



48  $\mu$  wide, 40 to 80  $\mu$  long (30 by 60  $\mu$  according to Jägerskiöld, 45 by 60  $\mu$  according to Nicoll, 30 by 40  $\mu$  according to Linton, 66 to 80  $\mu$  long according to Wigdor). Esophagus short (280 to 320  $\mu$  long according to Jägerskiöld, but shown in his figure as about 50  $\mu$  long, 40



FIGS. 14-15. 14.—CRYPTOCOTYLE LINGUA FROM DOG (HALLUM CANINUM, WIGDOR'S SPECIMEN). VENTRAL VIEW.  $\times 110$ . ORIGINAL. 15.—CRYPTOCOTYLE LINGUA FROM SEAL. VENTRAL VIEW.  $\times 110$ . ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

to 60  $\mu$  according to Nicoll and Wigdor). Bifurcation of intestine one-tenth to one-third the body length from the anterior end. Genital sucker near the middle of the body, transverse diameter 120 to



250  $\mu$  (180 to 250  $\mu$  according to Jägerskiöld, 136 to 184  $\mu$ , Wigdor). Ventral sucker, 55 to 85  $\mu$  in diameter, its cavity connecting with the genital sinus by a narrow tube. Right testis obliquely behind the left. Testes slightly lobed, irregularly globular or oval, 120 to 250  $\mu$  by 70 to 130  $\mu$  (about 250 by 130  $\mu$  according to Jägerskiöld). Ovary lobulated, may present the outline of a clover leaf; width, 140 to 180  $\mu$ ; length, 70 to 120  $\mu$  (width 180  $\mu$ , length 80  $\mu$ , thickness 120  $\mu$ , according to Jägerskiöld). Vitellaria extend anteriorly beyond the level of the ventral sucker, usually a considerable distance, encroaching upon the median field in front of the ventral sucker, sometimes merging in the median line. Posteriorly they fill up most of the post-testicular region, and commonly cross the median line on the dorsal side of the excretory vesicle. Distance from the transverse vitelline ducts to the center of the ventral sucker greater than the distance from the latter to the anterior limits of the vitellaria, usually considerably greater, and may be four times as great. Eggs, 40 to 50  $\mu$  long by 18 to 25  $\mu$  wide (42 by 20  $\mu$ , Olsson, 1876*b*; 48 by 22  $\mu$ , Jägerskiöld; 47 to 49  $\mu$  by 22 to 25  $\mu$ , Nicoll; 40 by 20  $\mu$  to 47 by 23  $\mu$ , Linton; the minimum length given by Wigdor appears to be abnormal; according to him the length is 32 to 48  $\mu$ , width 18 to 22  $\mu$ ).

*Immature encysted stage.*—Cysts 0.32 to 0.36 mm. in diameter, with transparent wall about 50  $\mu$  thick, surrounded by masses of black pigment cells; surface of cyst not covered by pigment. Worms extracted from cysts, 0.47 to 0.82 mm. long, 0.17 to 0.2 mm. broad. Oral sucker 50 to 60  $\mu$  wide. Pharynx 40 to 48  $\mu$  long by 21 to 35  $\mu$  wide. Surface of body covered with a dense coat of cuticular scales. Arrangement of internal organs, or of their rudiments, similar to that in the adult worms.

*Hosts.*—*Colymbus auritus*; *Gavia imber*; *Larus marinus*; *L. argentatus*; *L. fuscus*; *L. atricilla*; *Nycticorax nycticorax*; *Rissa tridactyla*; *Alca torda*; *Sterna dougalli*; *S. hirundo*; *Canis familiaris*; and *Phoca vitulina*. Immature stages encysted in cunner (*Tautogolabrus adspersus*); tautog (*Tautoga onitis*) and other fishes.

*Location.*—Intestine. (Immature stages encysted in skin and gills of fishes and free among adults in intestines of final hosts.)

*Localities collected.*—Europe; United States (Detroit, Michigan, Woods Hole, Massachusetts, and Washington, District of Columbia); Nova Scotia (Cape Breton).

Looss (1899*b*) took *lingua* as the type of the genus *Tocotrema* but its characters are so similar to those of the type of *Cryptocotyle* (*C. concava*) that the two can not be separated generically.

The most complete description of *C. lingua* is that given by Jägerskiöld (1899*a*). Nicoll (1907*b*) and Linton (1915) have added further data. Wigdor (1918) redescribed it as a new species. *Hallum*

*caninum*, from specimens taken from the small intestine of a dog at Detroit, Michigan, August 6, 1918, and made it the type of the genus *Hallum*. Through the courtesy of Parke, Davis, and Co., the writer has had the opportunity of examining three of Wigdor's specimens which have been entered in the Bureau of Animal Industry Helminthological Collections of the United States National Museum (No. 19028). These collections also contain some specimens of *C. lingua* collected from the intestine of *Phoca vitulina* by Dr. Albert Hassall, at the National Zoological Park, Washington City, December 21, 1905. (U.S.N.M. No. 4280.) The flukes from the dog (fig. 14) and the seal (fig. 15) measure 0.88 to 1.14 mm. in length, 0.34 to 0.56 mm. in width. The oral sucker is 70 to 110  $\mu$  in diameter. Pharynx, 40 to 48  $\mu$  in width by 50 to 60  $\mu$  in length. Ventral sucker, 60 to 85  $\mu$  in transverse diameter; genital sucker, 120 to 180  $\mu$  in transverse diameter. The distance from the anterior end of the body to the bifurcation of the intestine varies from 130 to 260  $\mu$ . The testes measure 120 to 200  $\mu$  by 70 to 120  $\mu$ ; ovary, 100 to 180  $\mu$  by 70 to 120  $\mu$ ; seminal receptacle, 60 to 120  $\mu$  in diameter. The eggs vary from 40 to 50  $\mu$  in length and from 18 to 24  $\mu$  in width. Wigdor evidently mistook the genital sucker for the ventral sucker, and interpreted the latter as the genital pore, also apparently confused the seminal vesicle and the uterus in his description of *Hallum caninum*.

Ryder (1884a) recorded the occurrence of encysted flukes in the skin, gills, and mouth of cunners caught at Woods Hole, Massachusetts, and Cape Breton, Nova Scotia. Linton (1900a, 1901b) recorded similar parasites from cunners and tautogs. Stafford (1905a) named these worms *Dermocystis ctenolabri*. Linton more recently (1915) has found these parasites in various other species of fish in the Woods Hole region and has secured very good evidence that they are immature stages of *C. lingua* which occurs among various fish-eating birds in the same region. They not only correspond morphologically with *C. lingua* but similar immature forms have been found among adults of *C. lingua* in the intestines of the final hosts.

CRYPTOCOTYLE JEJUNA (Nicoll, 1907) Ransom, 1920.

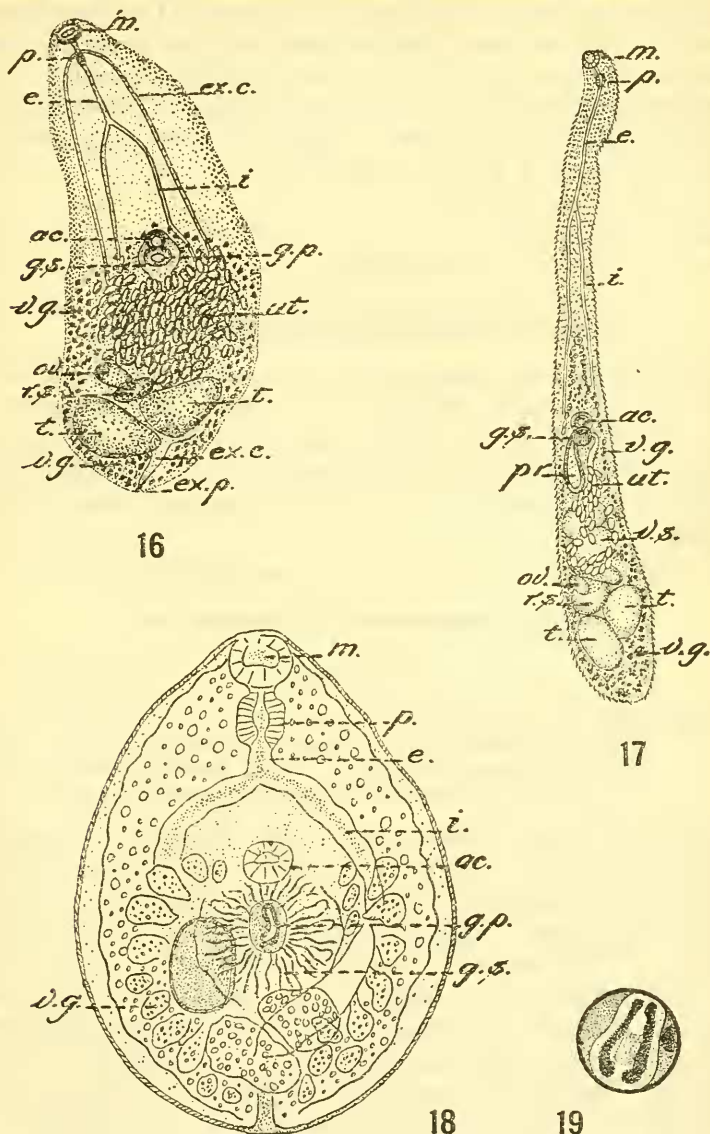
Figs. 16, 17.

1907. *Tocotrema jejunum* NICOLL, 1907f, pp. 248, 257-259; 1909, p. 483, pl. 10, figs. 20, 21.

1920. *Cryptocotyle jejuna* (Nicoll, 1907) RANSOM, 1920 (the present paper).

*Specific diagnosis*.—*Cryptocotyle*: Maximum length about 1.8 mm., maximum width varying from one-eighth to one-third the length. Oral sucker about 45  $\mu$  in diameter. Pharynx, 38  $\mu$  long by 18  $\mu$  wide; prepharynx somewhat shorter than pharynx. Average length of esophagus about 100  $\mu$ , nearly one-twelfth the body length. Geni-

tal sucker about  $55\ \mu$  in transverse diameter. Testes irregularly oval, with indentations on their posterior border; right testis obliquely behind the left. Seminal vesicle voluminous, extending back as far as



FIGS. 16-19. 16.—*CRYPTOCOTYLE JEJUNA*. CONTRACTED SPECIMEN. VENTRAL VIEW.  $\times 49$ . AFTER NICOLL, 1909. 17.—*CRYPTOCOTYLE JEJUNA*. ELONGATED SPECIMEN. VENTRAL VIEW.  $\times 49$ . AFTER NICOLL, 1909. 18.—*PARACOENOGONIMUS OVATUS*. VENTRAL VIEW OF IMMATURE WORM FROM MOUSE.  $\times 188$ . AFTER KATSURADA, 1914. 19.—*PARACOENOGONIMUS OVATUS*. ENCYSTED CERCARIA FROM FISH.  $\times 27$ . AFTER KATSURADA, 1914. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

anterior testis, highly convoluted. Prostatic portion of vas deferens well developed, forming a pear-shaped body enclosed by a distinct membrane. Ovary small, roughly oval, lobed, a short distance in

front of testes on right of median line. Seminal receptacle near median line between ovary and testes. Vitellaria purely lateral in position except at the level of the genital sucker, where they bend in on each side and form a complete arch in front of the ventral sucker, the anterior limits of their distribution being in the immediate neighborhood of the level of the ventral sucker. Uterus arranged in three fairly regular transverse convolutions, laterally not extending much beyond the intestinal branches. Eggs numerous, light brown in color, 31 to 36  $\mu$  long by 16 to 19  $\mu$  wide.

*Host*.—*Totanus calidris*.

*Location*.—Intestine.

*Locality collected*.—Great Britain.

Genus PARACOENOGONIMUS Katsurada, 1914.

*Generic diagnosis*.—Heterophyidae: In characters thus far described resembles genus *Cryptocotyle* except that the egg is very large, over 100  $\mu$  long. Immature stage (encysted cercaria) in muscles of fresh-water fishes; adults presumably in intestine of fish-eating animals, young adults having been reared in mice fed with cercariae.

*Type species*.—*Paracoenogonimus ovatus* Katsurada, 1914.

PARACOENOGONIMUS OVATUS Katsurada, 1914.

Figs. 18, 19.

1914. *Paracoenogonimus ovatus* KATSURADA, 1914, pp. 313, 314, figs. 7, 8, 9, 12, 13 (immature stage in muscles of fishes, Plötzen, Brachsen, Barben, Plinten, Ukelei, etc.; Rivers Elbe and Alster, Germany; young adults in intestines of experimentally infected mice).

*Specific diagnosis*.—*Paracoenogonimus*: Young individual from intestine of mouse, four days after feeding immature stages in the muscles of "Alsterplötze," measured 0.522 mm. long, 0.378 mm. broad; oval in shape. Pharynx close behind the oral sucker; esophagus short. Bifurcation of intestine at the beginning of the second fourth of the body. Intestinal ceca extend into the posterior portion of the body. Ventral sucker about midway of the body, considerably smaller than the oral sucker; musculature very weakly developed. Genital pore median, a short distance behind the ventral sucker and surrounded by a genital sucker. Testes irregularly oval near posterior end of body; right testis obliquely behind the left. Vitellaria in lateral fields extending from the level of the ventral sucker into the post-testicular region. A single egg present, 116  $\mu$  long by 76  $\mu$  wide; brownish-yellow in color.

*Immature stage* (encysted cercaria).—Cysts rounded; 324  $\mu$  in diameter, wall of cyst 28.8  $\mu$  thick (Elbplötze); 317  $\mu$  by 306  $\mu$  in



diameter (Elbbrachsen) ; 360  $\mu$  in diameter, surrounded by a fibrous granular envelope 90  $\mu$  thick (Barbe). Cercaria from cyst, oval in shape, with a very prominent excretory vesicle. Cuticle armed with fine spines. Size of cercaria 0.486 mm. long, 0.36 mm. wide; oral sucker 57.6  $\mu$  in diameter; pharynx, 32.4  $\mu$ .

*Hosts*.—Immature stage (encysted cercaria) in the muscles of fishes from the Rivers Elbe and Alster: Plötzen (apparently type host), Brachsen, Barben, Plinten, Ukelei, etc. Young adult in intestine of experimentally infected mouse. Usual host of adult unknown.

*Location*.—Immature stage in muscles of fish. Adult presumably in intestine of fish-eating mammal or bird.

*Localities collected*.—Germany (Rivers Elbe and Alster).

So far as may be determined from Katsurada's (1914) description and figures *Paracoenogonimus ovatus* corresponds to *Cryptocotyle*, the only discrepancy being in the size of the egg, no previously known species of this genus or of the family Heterophyidae having eggs so large. The egg of Katsurada's species is more than twice as large as that of any other species of Heterophyidae. Further investigations are necessary before the form described by Katsurada can be properly placed.

#### Genus APOPHALLUS Lühe, 1909.

*Generic diagnosis*.—Heterophyidae: Prepharynx present but much shorter than the long esophagus. Bifurcation of intestine nearer to ventral sucker than to oral sucker. Intestinal ceca extend into the posterior end of the body well behind the testes. Ventral sucker median, about midway of the body, opening to the exterior through the genital pore. The genital sinus, which opens to the exterior through the genital pore, and in which the vas deferens and vagina terminate, is situated immediately in front of the ventral sucker. Well-developed seminal vesicle behind the ventral sucker. Testes globular or oval, in posterior third of body, the right testis usually obliquely behind the left, but the two may be side by side at the same level. Seminal receptacle in front of and to the right of the left (anterior) testis. Ovary globular, on the right side of the median line, in front of the seminal receptacle. Vitellaria extend forward to about the level of the ventral sucker, may be limited to the lateral fields in this region, but may extend inward to the median line in front of the ventral sucker; posteriorly the lobules of the vitellaria are numerous behind the testes and between them, and often are present on the dorsal and ventral sides of the testes. Transverse vitelline ducts located in the neighborhood of the boundary between the

ovarian and testicular zones. Uterus disposed in a few loops in the median field, none in front of the genital pore.

*Type species.*—*Apophallus muehlingi* (Jägerskiöld, 1899) Lühe, 1909.

KEY TO SPECIES.

Vitellaria extend a short distance anteriorly beyond the level of the ventral sucker and encroach upon the median field in this neighborhood; eggs 36 to 40  $\mu$  long;  
American -----

*Apophallus brevis.*

Vitellaria do not extend anteriorly beyond the level of the ventral sucker and do not encroach upon the median field in this neighborhood; eggs 32.4  $\mu$  long; Euro-  
pean -----

*Apophallus muehlingi.*

**APOPHALLUS MUEHLINGI (Jägerskiöld, 1899) Lühe, 1909.**

Fig. 20.

1898. *Distomum lingua* CREPLIN of MUEHLING, 1898a, pp. 21-22; 1898b, pp. 29, 94-96, pl. 3, fig. 16 (in *Larus ridibundus*; misdetermination).

1899. *Distomum muehlingi* JÄGERSKIÖLD, 1899a, p. 7 (*lingua* of Muehling renamed as new species).

1899. *Tocotrema muehlingi* (Jägerskiöld, 1899) LOOSS, 1899b, p. 585.

1909. *Apophallus muehlingi* (Jägerskiöld, 1899) LÜHE, 1909, p. 62, fig. 53 (type of *Apophallus*).

*Specific diagnosis.*—*Apophallus*: Length, 1.2 to 1.6 mm.; width, 0.19 to 0.23 mm. Body much elongated, constricted near the middle in the region of the ventral sucker. Cutaneous scales, 2.9  $\mu$  long. Oral sucker, 54  $\mu$  in diameter. Prepharynx well developed (about as long as the diameter of the oral sucker according to Muehling's illustration). Pharynx, 37  $\mu$  in diameter. Testes globular, near the posterior end of the body; right testis obliquely behind the left. Ventral sucker of about the same size as the oral sucker. Genital sinus median, immediately in front of the ventral sucker. Seminal vesicle well developed, S-shaped, in median line behind the ventral sucker. Ovary globular or piriform, on right side of body between testes and ventral sucker, but nearer to the anterior testis than to the ventral sucker. Vitellaria do not extend anteriorly beyond the level of the ventral sucker and do not encroach upon the median field in this neighborhood. Posteriorly they are numerous in the median field behind the testes, between them, in front of them, and on the dorsal sides of the testes. Uterus relatively short, containing only a few eggs, which are brownish in color, 32.4  $\mu$  long by 18  $\mu$  wide.

*Host.*—*Larus ridibundus*.

*Location.*—Intestine.

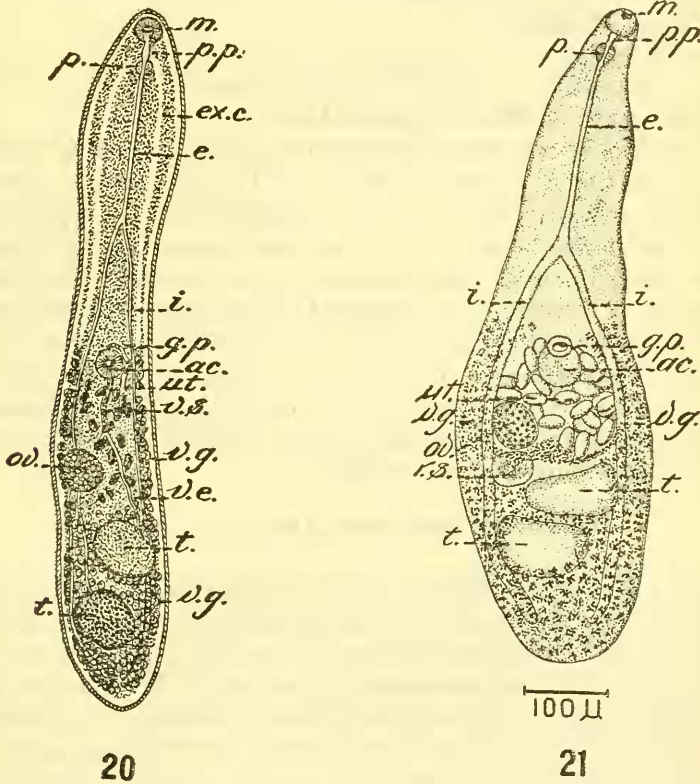
*Locality collected.*—East Prussia.

## APOPHALLUS BREVIS, new species.

Fig. 21.

1920. *Apophallus brevis* RANSOM, 1920 (the present paper) (in *Larus delawarensis*; U. S.).

*Specific diagnosis.*—*Apophallus*: Length, 0.6 to 0.9 mm.; width, 0.13 to 0.26 mm. Cutaneous scales about  $4\ \mu$  long by  $2\ \mu$  wide. Oral sucker, 30 to  $50\ \mu$  in diameter; prepharynx not over  $20\ \mu$  in length; pharynx, 20 to  $28\ \mu$  in diameter. Bifurcation of intestine about one-third the body length from the anterior end. Ventral sucker in



FIGS. 20-21. 20.—*APOPHALLUS MUEHLINGI*. VENTRAL VIEW.  $\times$  ABOUT 60. AFTER MUEHLING, 1898.  
21.—*APOPHALLUS BREVIS*. VENTRAL VIEW.  $\times$  110. ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

about the middle of the body, 35 to  $55\ \mu$  in diameter, opening to the exterior through the genital pore. Right testis usually obliquely behind the left, but the two may be located side by side right and left of the median line, 45 to  $145\ \mu$  in transverse diameter, 45 to  $120\ \mu$  in longitudinal diameter. Distance of posterior testis from the posterior end of the body at least as great as the longitudinal diameter of the testis. Seminal receptacle, 40 to  $80\ \mu$  in diameter. Ovary, globular or oval, 50 to  $80\ \mu$  in transverse diameter, 60 to  $90\ \mu$  in longitudinal diameter. Vitellaria extend anteriorly a short distance



beyond the level of the ventral sucker, encroaching on the median field in this neighborhood, and may unite in front of the ventral sucker. Distance from the transverse vitelline ducts to the center of the ventral sucker always somewhat greater than the distance from the latter to the anterior limits of the vitellaria, and may be twice as great. Posteriorly the vitellaria fill up most of the post-testicular zone, crossing the median line, also present between the testes, and may have numerous lobules on the dorsal and ventral sides of the testes. Eggs 36 to 40  $\mu$  long by 16 to 22  $\mu$  wide.

*Host*.—*Larus delawarensis*.

*Location*.—Intestine.

*Locality collected*.—Washington, District of Columbia.

*Type specimens*.—U.S.N.M. Helminthological Collections No. 2845, collected by Dr. A. Hassall, March, 1897.

*Apophallus brevis* is very similar to *A. muehlingi*. It is somewhat smaller, relatively broader posteriorly. The oral sucker is smaller, 30 to 50  $\mu$  as compared to 54  $\mu$ . The pharynx is also smaller, 20 to 28  $\mu$  as compared to 37  $\mu$ . The vitellaria extend farther forward, and encroach upon the median field in front of the ventral sucker, whereas in *A. muehlingi* as described by Muehling (1898*b*) they do not extend forward of the level of the ventral sucker nor into the median field anteriorly. The eggs are larger, 36 to 40  $\mu$  long in *A. brevis*, 32.4  $\mu$  long in *A. muehlingi*. Considering these differences it appears that *A. brevis* is specially distinct from *A. muehlingi*, though they are very similar to one another.

#### Genus COTYLOPHALLUS, new genus.

*Generic diagnosis*.—Heterophyidae: Prepharynx very short, practically absent. Bifurcation of intestine nearer to ventral sucker than to oral sucker. Intestinal ceca extend into the posterior part of the body, ending in the neighborhood of the level of the posterior border of the right testis. Ventral sucker median, one-third to one-half the body length from the anterior end, opening to the exterior through the genital pore. The genital sinus which opens to the exterior through the genital pore and in which the vas deferens and vagina terminate, is situated immediately in front of the ventral sucker. Prostatic portion of vas deferens well developed, situated posterior and dorsal of, and to the left of, the ventral sucker. Seminal vesicle well developed, forming a U-shaped loop, with its limbs one in front of the other, posterior and dorsal of the ventral sucker, dorsal of the coils of the uterus, base of the U to the right near the right branch of the intestine. Testes near posterior end of body, oval or globular; right testis obliquely behind the left. Seminal receptacle in front of and to the right of the left testis. Ovary globular or elongated,

sometimes bent upon itself with one lobe dorsal, the other ventral, and situated on the right side of the median line in front of and ventral of the seminal receptacle. Vitellaria extend across body in front of genital pore, on the dorsal side of the branches of the intestine, and often meet in the median line. Anterior limits of the vitellaria in the region of the bifurcation of the intestine; posteriorly they extend behind the testes, but do not cross the median line. Transverse vitelline ducts located in the neighborhood of the boundary between the ovarian and testicular zones. Uterus disposed in a few loops in the median field; none in front of the genital pore.

*Type species.*—*Cotylophallus venustus* Ransom, 1920.

#### KEY TO SPECIES.

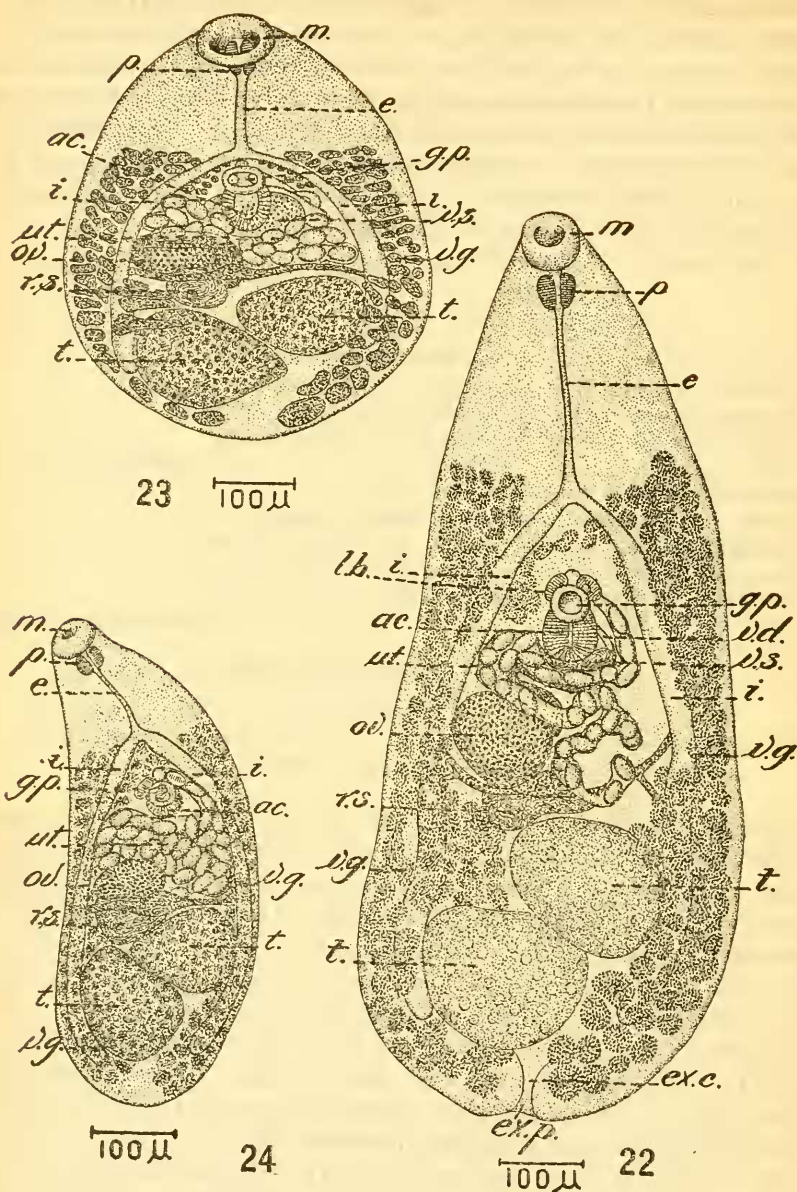
- Vitellaria with numerous lobules extending entirely across body in region between genital pore and bifurcation of intestine, elsewhere lobules disposed mostly in a single row right and left along the outer sides of the intestinal ceca ----- *Cotylophallus similis*.  
 Lobules of vitellaria relatively not numerous in region in front of the genital pore, very scarce towards the median line, elsewhere disposed in several rows along the outer sides of the intestinal ceca and lapping over the latter dorsally and ventrally in the posterior half of the body ----- *Cotylophallus venustus*.

#### COTYLOPHALLUS VENUSTUS, new species.

Figs. 22-25.

1920. *Cotylophallus venustus* RANSOM, 1920 (the present paper), (type of *Cotylophallus*; in *Vulpes lagopus*; dog; cat; U. S.).

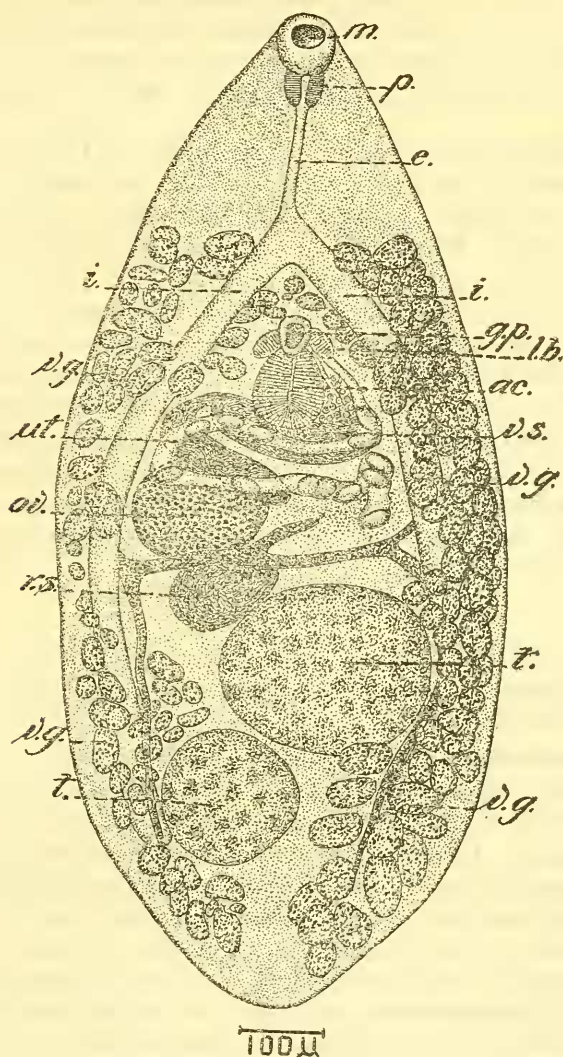
*Specific diagnosis.*—*Cotylophallus*: Length up to 1.3 mm.; maximum width, 0.23 to 0.65 mm., the length in expanded specimens being from twice to about three times the maximum width. Cutaneous scales about 5  $\mu$  long by 1.5 to 3.5  $\mu$  wide. Oral sucker, 40 to 90  $\mu$  in diameter. Pharynx, 30 to 70  $\mu$  in diameter. Bifurcation of intestine one-fifth to a little over one-third the body length from the anterior end; intestinal ceca extend into posterior fourth of body. Ventral sucker, 36 to 100  $\mu$  in diameter; 120 to 600  $\mu$ , or one-third to one-half the body length from the anterior end. Testes in posterior third of body, oval or globular; major diameter, 75 to 320  $\mu$ . Ovary, 70 to 180  $\mu$  in its major diameter, situated 200 to 800  $\mu$  (from about one-half to two-thirds the body length) from the anterior end of body. Vitellaria with comparatively few lobules in front of the level of the anterior border of the ventral sucker, very scarce in the median line; behind the level of the ventral sucker, being arranged in several rows along the outer sides of the intestinal ceca and testes, frequently overlapping the intestinal ceca; commonly a considerable



FIGS. 22-24. 22.—*COTYLOPHALLUS VENUSTUS* FROM FOX. VENTRAL VIEW.  $\times 110$ . ORIGINAL. 23.—*COTYLOPHALLUS VENUSTUS* FROM CAT. VENTRAL VIEW.  $\times 110$ . ORIGINAL. 24.—*COTYLOPHALLUS VENUSTUS* FROM CAT. VENTRAL VIEW.  $\times 110$ . ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]



number of lobules in the space between the right testis and the ovary. Distance from the transverse vitelline ducts to the center of the



25

FIG. 25.—COTYLOPHALLUS VENUSTUS FROM DOG. VENTRAL VIEW.  $\times 110$ . ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

ventral sucker usually somewhat greater than from the latter to the anterior limits of the vitellaria. Eggs, yellowish-brown, 25 to 35  $\mu$  long by 15 to 20  $\mu$  wide.

*Hosts*.—Alaskan fox (*Vulpes lagopus*); dog; cat.

*Location*.—Intestine.

*Locality collected*.—Washington, District of Columbia.

*Type specimens*.—United States National Museum Helminthological Collections No. 19031, collected from an Alaskan fox, National Zoological Park, Washington City, by Dr. H. W. Graybill, May 2, 1906.

Besides the type specimens of *C. venustus*, the United States National Museum Collections contain specimens collected by Dr. E. C. Stevenson from foxes August 9, 1906 (No. 4487), and December 17, 1906 (No. 4657). There are also in the collections specimens collected by Stevenson from a dog May 25, 1907 (No. 14472), and specimens collected by Lieut. Col. E. R. Whitmore from the small intestine of a cat in 1918 (No. 19022), all in Washington, D. C.

The specimens from the cat (figs. 23, 24) are much smaller (0.3 to 0.7 mm. long, 0.23 to 0.45 mm. wide) than those from the foxes (fig. 22) and the dog (fig. 25), most of them quite immature and not yet containing eggs. Some of the largest contain a few eggs. The differences between the specimens from the cat and those from the fox, however, do not appear sufficient to justify the recognition of a distinct species.

**COTYLOPHALLUS SIMILIS, new species.**

Fig. 26.

1920. *Cotylophallus similis* RANSOM, 1920 (the present paper), (in *Phoca vitulina*; U. S.).

*Specific diagnosis*.—*Cotylophallus*: Maximum length, 1.14 mm., usually between 0.5 and 0.9 mm.; maximum breadth, 0.22 to 0.39 mm. Cutaneous scales 1.5 to 3  $\mu$  wide, 4 to 7.5  $\mu$  long. Oral sucker, 65 to 85  $\mu$  in diameter. Pharynx, 30 to 44  $\mu$  in transverse diameter. Bifurcation of intestine, 135 to 265  $\mu$  (from about one-fourth to a little over one-third the body length) from the anterior end of the body; intestinal ceca extend into posterior fourth of body. Ventral sucker, 185 to 560  $\mu$  (about one-half, usually a little less than one-half the body length) from the anterior end of the body, 48 to 60  $\mu$  wide by 45 to 68  $\mu$  long. Testes in posterior third of body, oval or globular, 80 to 200  $\mu$  by 60 to 200  $\mu$ . Ovary 65 to 140  $\mu$  by 40 to 120  $\mu$ , situated 200 to 750  $\mu$  (about two-thirds the body length) from the anterior end of the body. Seminal receptacle, 60 to 130  $\mu$  by 35 to 90  $\mu$ . Vitellaria with numerous lobules extending across the body between the levels of the anterior border of the ventral sucker and the bifurcation of the intestine; behind the level of the ventral sucker, being arranged mostly in a single row on each side of the body along the outer sides of the intestinal ceca and testes; lobules scarce in the

space between the right testis and ovary. Distance from the transverse vitelline ducts to the center of the ventral sucker usually somewhat less than the distance from the latter to the anterior limits of the vitellaria. Eggs yellowish-brown, 30 to 35  $\mu$  long by 16 to 20  $\mu$  wide.

*Host*.—Harbor seal (*Phoca vitulina*).

*Location*.—Intestine.

*Locality collected*.—Washington, District of Columbia (National Zoological Park).

*Type specimens*.—United States National Museum Helminthological Collections No. 4279, collected by Dr. Albert Hassall, December 21, 1905.

*Cotylophallus similis* is very close to *C. venustus*, but is distinguishable from the latter by the relatively greater development of the vitellaria anteriorly and their restricted development posteriorly. In *C. venustus* there are not only a greater number of lobules of the vitellaria along the outer sides of the intestinal ceca, but the number in the spaces between the right testis and ovary and behind the left testis is much greater than in *C. similis*. Another almost constant difference is seen in the ratios of the distances between the transverse vitelline ducts, ventral sucker, and anterior limits of the vitellaria.

#### Genus CENTROCESTUS Looss, 1899.

*Generic diagnosis*.—Heterophyidae: Mouth surrounded by a double crown of spines. Prepharynx long. Pharynx near the bifurcation of the intestine. Intestinal ceca extend into the posterior region of the body. Ventral sucker median. Genital sinus median, immediately in front of the ventral sucker. Prostatic portion of vas deferens well developed, situated along the right side of the ventral sucker. Well-developed seminal vesicle behind the ventral sucker, arranged in a U-shaped loop extending across the median field, the anterior limb of the loop the longer, base of the U to the left. Testes oval, elongated transversely, near posterior border of body, side by side, right and left of the median line. Seminal receptacle median, in front of testes. Ovary to the right of the seminal receptacle, in front of right testis, ovoid in form. Vitellaria arranged in numerous lobules in the lateral fields, extending from the region behind the testes nearly to the bifurcation of the intestine, encroaching upon the median field in front of the ventral sucker, and extending in this region inwards to or nearly to the median line. Transverse vitelline ducts in neighborhood of boundary between the ovarian and testicular zones. Uterus arranged in a few transverse loops, in the space between the testes and the ventral sucker. Terminal portion of uterus (vagina) passes forward to the genital sinus along the left side of the ventral sucker.

*Type species*.—*Centrocestus cuspidatus* (Looss, 1896) Looss, 1899.



## CENTROCESTUS CUSPIDATUS (Looss, 1896) Looss, 1899.

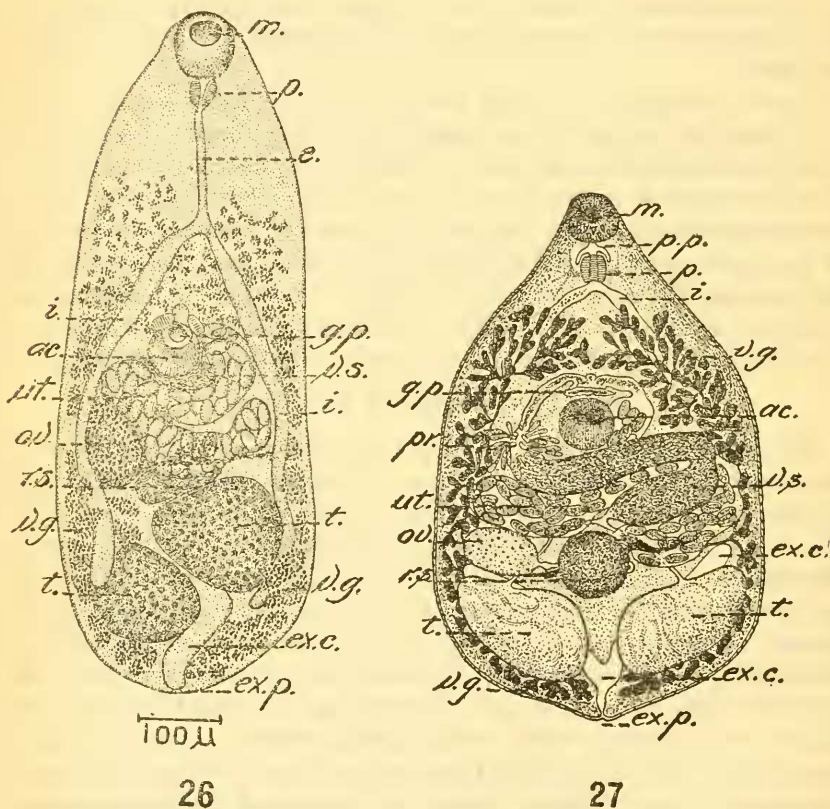
Fig. 27.

1896. *Distomum cuspidatum* Looss, 1896b, pp. 97-101, 104, pl. 7, figs. 64-65 (in *Milvus parasiticus*; Egypt).

1899. *Anoiktostoma cuspidatum* (Looss, 1896) Stossich, 1899c, p. 15.

1899. *Centrocestus cuspidatus* (Looss, 1896) Looss, 1899b, pp. 582, 584 (type of *Centrocestus*).

1913. *Centrocestus cuspidatus caninus* LEIPER, 1913, pp. 176-177, 1 fig. (in dog; Formosa).



FIGS. 26-27. 26.—COTYLOPHALLUS SIMILIS. VENTRAL VIEW.  $\times 110$ . ORIGINAL. 27.—CENTROCESTUS CUSPIDATUS. VENTRAL VIEW.  $\times 123$ . AFTER LOOSS, 1896. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

*Specific diagnosis.*—*Centrocestus*: About 0.5 mm. long by 0.35 mm. wide when contracted, 0.75 to 0.8 mm. long when extended. Oral sucker, 50  $\mu$  in diameter. Mouth surrounded by a double crown of spines, 36 in number, 18 in each row, 10  $\mu$  long by 3  $\mu$  wide at the base. Pharynx, 30  $\mu$  long by 25  $\mu$  wide, separated from the oral sucker by a well-developed prepharynx. When the neck is extended the distance between the oral sucker and the pharynx may reach

150  $\mu$ . Bifurcation of intestine immediately behind the pharynx. Intestinal ceca extend into the posterior portion of the body, but their termination has not been definitely determined. Ventral sucker, 60  $\mu$  in diameter, located in contracted specimens at the beginning of the middle third of the body. Genital sinus transversely elongated, situated immediately in front of the ventral sucker. Testes 150 by 80  $\mu$  in diameter. Seminal vesicle very large. Prostatic portion of vas deferens well developed, cavity may be enlarged spherically to a diameter of 20  $\mu$ ; terminal portion of vas deferens opening into the genital sinus may attain a diameter of 20  $\mu$ . Seminal receptacle may attain a diameter of 70  $\mu$ . Vitellaria are nearer the dorsal than the ventral surface, and extend from the neighborhood of the excretory pore in the posterior end of the body forward along the lateral borders and bend inward in front of the ventral sucker and behind the bifurcation of the intestine, nearly meeting in the median line. Uterus terminates in a vagina about 50  $\mu$  long, which empties into the genital sinus. Eggs yellowish-brown, 30 by 15  $\mu$  in diameter.

*Hosts*.—*Milvus aegyptius* (= *M. parasiticus*); dog.

*Location*.—Intestine.

*Localities collected*.—Egypt; Formosa.

Leiper (1913, pp. 176–177) describes and figures a fluke found in the feces of a dog in Formosa that corresponds to *C. cuspidatus*, but shows only 28 spines surrounding the mouth. As the single specimen collected was in a poor state of preservation, Leiper suggests that some of the spines originally present may have been lost. Leiper proposes that the fluke from the dog in Formosa be recognized as a variety, *Centrocestus cuspidatus caninus*, until material for further study is available, as it appears questionable to him that the same fluke should be found in the kite in Egypt and in the dog in Formosa.

#### Genus ASCOCOTYLE Looss, 1899.

*Generic diagnosis*.—Heterophyidae: Mouth surrounded by a crown of spines. Oral sucker with an elongated posterior cecum, extending backward on the dorsal side of the prepharynx. Prepharynx long. Pharynx near the bifurcation of the intestine. Bifurcation of intestine nearer to the ventral sucker than to the oral sucker. Ventral sucker median, posterior of the middle of the body, opening to the exterior, in some species, if not in all, through the genital pore. The genital sinus, which opens to the exterior through the genital pore, and in which the vas deferens and vagina terminate, is situated immediately in front of the ventral sucker. Well-developed seminal vesicle behind the ventral sucker. Testes globular or oval, side by side, near posterior end of body. Seminal receptacle in front of

testes. Ovary globular or oval, on right side of median line in front of seminal receptacle. Vitellaria not extending anterior of region of genital pore. Coils of uterus frequently overlap the intestinal ceca, but usually do not extend in front of genital pore. Eggs not over 25  $\mu$  long.

*Type species*.—*Ascocotyle coleostoma* (Looss, 1896) Looss, 1899.

#### KEY TO SPECIES.

1. Intestinal ceca short, do not extend back of posterior border of ventral sucker----- 2.  
Intestinal ceca extend a considerable distance behind the level of the ventral sucker----- 3.
2. Mouth surrounded by a double crown of spines; vitellaria extend forward into region of the ventral sucker----- *Ascocotyle coleostoma*.  
Mouth surrounded by a single crown of spines; vitellaria do not extend anteriorly beyond the level of the ovary----- *Ascocotyle minuta*.
3. Circumoral spines about 70  $\mu$  long; some of uterine coils in front of genital pore----- *Ascocotyle angrense*.  
Circumoral spines less than 25  $\mu$  long; uterus limited to region between testes and genital pore----- 4.
4. Oral cecum more than half the length of the prepharynx; circumoral spines 16 to 24  $\mu$  long----- *Ascocotyle longa*.  
Oral cecum less than half the length of the prepharynx; circumoral spines less than 15  $\mu$  long----- *Ascocotyle nana* or *Ascocotyle italica*.

#### ASCOCOTYLE COLEOSTOMA (Looss, 1896) Looss, 1899.

##### Fig. 31.

1896. *Distomum colcostomum* Looss, 1896b, pp. 101–106, 154, pl. 7, figs. 66–68 (in pelican; Egypt); 1899b, pp. 578, 581, 585 (type of *Ascocotyle*).

1899. *Ascocotyle coleostoma* (Looss, 1896) Looss, 1899b, pp. 582, 585, 699 (type of *Ascocotyle*).

*Specific diagnosis*.—*Ascocotyle*: Length, 0.7 to 0.8 mm.; maximum width, 0.25 mm. Cutaneous scales, 5  $\mu$  long. Mouth surrounded by a double crown of spines, 16 in each row, those of the anterior row 13  $\mu$  long, those of the posterior row a little shorter. Dorsal lip prolonged anteriorly in a short triangular process. Oral sucker, 90  $\mu$  in diameter; cavity funnel-like, continuous posteriorly with a hollow tapering process 230  $\mu$  long, usually bent in the form of an S. Pharynx, 60  $\mu$  long by 50  $\mu$  wide, immediately in front of the bifurcation of the intestine. Branches of intestine very short (150  $\mu$ ), terminating in front of the level of the ventral sucker. Ventral sucker about midway of the body in contracted specimens. Testes irregularly round or oval; maximum diameter, 70  $\mu$ . Ovary irregularly spherical; maximum diameter, 60  $\mu$ . Seminal receptacle posterior of ovary, spherical, 80  $\mu$  in diameter. Vitellaria in lateral fields extending from the level of the anterior borders of the testes to the level of the genital pore. Transverse vitelline ducts at about

the level of the middle of the ovary. Coils of uterus extend from the anterior borders of the testes to the branches of the intestine, one or more coils being in front of the genital pore. Eggs, 15  $\mu$  long by 10  $\mu$  wide, with thick dark-colored shells.

*Host*.—Pelican (*Pelecanus onocrotalus*).

*Location*.—Ceca and large intestine.

*Locality collected*.—Alexandria, Egypt.

ASCOCOTYLE MINUTA Looss, 1899.

Fig. 28.

1899. *Ascocotyle minuta* Looss, 1899b, pp. 585, 689–699, 700, 701, pl. 26, fig. 23 (in dog, cat and *Ardea cinerea*; Egypt).

*Specific diagnosis*.—*Ascocotyle*: Length, about 0.5 mm.; maximum breadth, about 0.22 mm.; neck in extended condition may be reduced to a thickness of 17  $\mu$ . Oral sucker about 40  $\mu$  in diameter. Circumoral spines cylindrical, abruptly pointed posteriorly, 18 to 20 in number, arranged in a single crown; dorsal spines, 13  $\mu$ , ventral spines, 12  $\mu$  long. Oral cecum, 50 to 66  $\mu$  long. Ventral sucker, 45 to 56  $\mu$  in diameter, in the beginning of the broader, posterior portion of the body. Pharynx, 41  $\mu$  long by 24  $\mu$  wide, almost cylindrical, lies in the posterior region of the neck, a short distance in front of the bifurcation of the intestine. Intestinal ceca short; do not extend posterior of the region of the ventral sucker. Testes very small, oval, long axis transverse. Ovary in front of right testis and of similar size. Seminal receptacle in median line in front of testes. Vitellaria in lateral fields in posterior end of body, not reaching the level of the ventral sucker anteriorly. Eggs with relatively thick yellowish-brown shells, 23 to 24  $\mu$  long by 14  $\mu$  wide.

*Hosts*.—Dog; cat; *Ardea cinerea*.

*Location*.—Middle portion of small intestine (dog, cat), intestine (*Ardea*).

*Localities collected*.—Egypt (Looss); Brazil (by Faria, according to Travassos, 1916).

ASCOCOTYLE ITALICA Alessandrini, 1906.

1906. *Ascocotyle italica* ALESSANDRINI, 1906, pp. 221–224 (in dog; Italy).

*Specific diagnosis*.—*Ascocotyle*: According to Alessandrini, very similar to *A. minuta* except in following characters: Dorsal lip apparently not projecting anteriorly as a triangular process. Intestinal ceca extend much behind the level of the ventral sucker, apparently reaching the excretory vesicle. Oral cecum much less than half the length of the prepharynx. Vitellaria not arranged in small scattered acini, but in two solid masses irregularly situated in the posterior part of the body. Testes much larger and much closer together. Eggs very numerous; uterus with numerous coils closely pressed together filling the space between the ventral sucker and testes.



*Host*.—Dog.

*Location*.—Intestine.

*Locality collected*.—Rome, Italy.

**ASCOCOTYLE ANGRENSE** Travassos, 1916.

1916. *Ascocotyle angrense* TRAVASSOS, 1916 (in *Butorides striata*; Brazil).

*Specific diagnosis*.—*Ascocotyle*: Length, 0.46 to 0.48 mm.; maximum width, 0.25 to 0.26 mm. Body piriform, concave ventrally. Cutaneous scales present in anterior portion. Oral sucker large. Circumoral spines cylindrical, with round points, about 72  $\mu$  long by 6  $\mu$  thick; ventral spines a little shorter than the dorsal spines. Oral cecum funicular in shape, 70  $\mu$  long. Ventral sucker 49  $\mu$  in diameter, situated about two-thirds the length of the body from the anterior end. Testes ellipsoidal, transversely elongated, about 106 by 71  $\mu$ . Ovary ellipsoidal, transversely elongated, anterior of testes, about 78 by 49  $\mu$  in diameter. Seminal vesicle large, elongated, behind ovary. Vitellaria small, composed of a few lobules situated in front and a little to the side of the testes. Uterus with numerous coils, some passing in front of ventral sucker. Eggs piriform, about 20  $\mu$  long by 10  $\mu$  wide.

*Host*.—*Butorides striata*.

*Location*.—Small intestine.

*Locality collected*.—Angra dos Reis, Est. do Rio, Brazil.

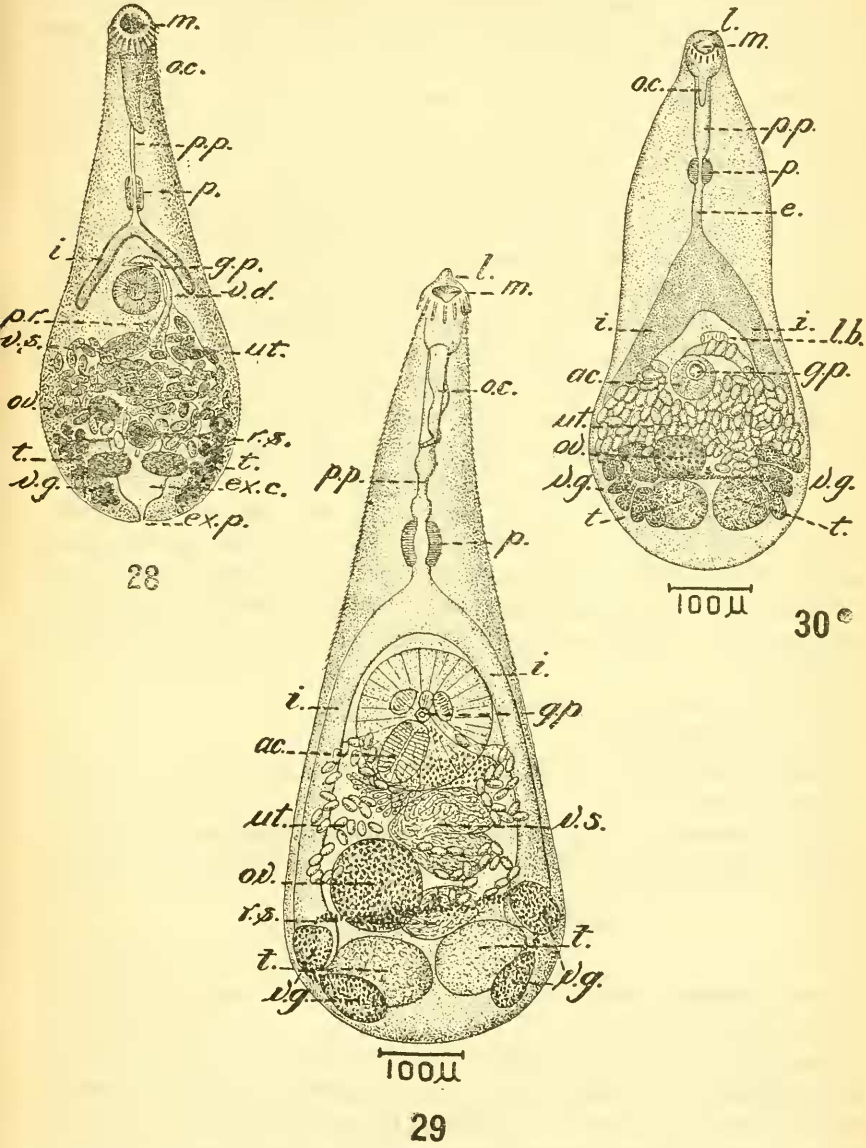
**ASCOCOTYLE LONGA**, new species.

Fig. 29.

1920. *Ascocotyle longa* RANSOM, 1920 (the present paper), (in *Vulpes lagopus*; U. S.).

*Specific diagnosis*.—*Ascocotyle*: Length, 0.85 to 1 mm.; maximum width, 0.27 to 0.35 mm. (near posterior end); body much attenuated anteriorly. Cutaneous scales about 7.5  $\mu$  long by 4  $\mu$  wide. Mouth surrounded by a single crown of heavy cylindrical spines with pointed posterior ends, 16 in number, those on the ventral side of the mouth varying from 16 to 18  $\mu$  in length, those on the dorsal side from 16 to 24  $\mu$ . Dorsal lip prolonged anteriorly in a short triangular process. Oral sucker, 80 to 85  $\mu$  long by 50 to 60  $\mu$  in transverse diameter, with a posterior hollow prolongation or oral cecum 140 to 160  $\mu$  long, about 20  $\mu$  in diameter anteriorly, tapering to a point posteriorly. The oral cecum is usually more or less bent and twisted especially near its posterior end. Pharynx globular or cylindrical, 45 to 60  $\mu$  in transverse diameter, located 190 to 350  $\mu$  from the anterior end of the body, about 50  $\mu$  in front of the bifurcation of the intestine. Intestinal ceca extend into posterior portion of body, terminating just in front of the testes. Ventral sucker, 50 to 55  $\mu$  wide by 70 to 75  $\mu$  long, situated 500 to 625  $\mu$  from the

anterior end of the body (a little over one-half the body length). Long axis of ventral sucker inclined with reference to the median line of the body, its posterior end being deflected to the right.



FIGS. 28-30. 8.—*ASCOCOTYLE MINUTA*. VENTRAL VIEW (THROUGH ERROR THE ORAL CECUM IS SHOWN ON THE VENTRAL INSTEAD OF THE DORSAL SIDE OF THE PREPHARYNX).  $\times 128$ . AFTER LOOSS, 1899. 29.—*ASCOCOTYLE LONGA*. VENTRAL VIEW.  $\times 110$ . ORIGINAL. 30.—*ASCOCOTYLE NANA*. VENTRAL VIEW.  $\times 110$ . ORIGINAL. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

Genital pore in the center of a usually conspicuous vesicular swelling about 160  $\mu$  in diameter, the tissue involved in this swelling being of very loose texture, amid which are situated the ventral sucker,

genital sinus, and two muscular bulbs, lenticular in shape, on the right and left sides of the genital sinus. Prostatic portion of vas deferens well developed, situated behind and to the left of the ventral sucker. In the left side of the median field behind the prostatic portion of the vas deferens a large U-shaped seminal vesicle, the base of the U being slightly to the right of the median line. Testes oval, transversely elongated, in posterior sixth of body, measuring 75 to 135  $\mu$  by 50 to 95  $\mu$ . Seminal receptacle may attain a size of 100 by 75  $\mu$ , situated about in the median line just in front of the testes. Ovary globular or oval, 80 to 130  $\mu$  in its major diameter, in front of the right testis ventral of and to the right and in front of the seminal receptacle. Distance of center of ovary 670 to 800  $\mu$  (four-fifths the body length or a little more) from the anterior end of the body. Vitellaria in the posterior end of the body, consisting of 2 to 6 lobules in each lateral field, anterior limits in the posterior portion of the zone occupied by the ovary and seminal receptacle. A transverse vitelline duct extends inwards from the anterior portions of the vitellaria from each side, the two uniting near the median line, the right and left duct, respectively, passing on the ventral side of the ovary and seminal receptacle. Uterus forms four or five transverse loops in the median field, ventral of the seminal receptacle, ovary, and seminal vesicle, and often extending into the lateral fields on the ventral side of the intestinal ceca. Eggs, yellowish-brown, 16 to 18  $\mu$  long by 9 to 11  $\mu$  wide.

*Host*.—Alaskan fox (*Vulpes lagopus*).

*Location*.—Intestine.

*Locality collected*.—Washington, District of Columbia (National Zoological Park).

*Type specimens*.—United States National Museum Helminthological Collections No. 4448, collected by Dr. H. W. Graybill, May 2, 1906.

**ASCOCOTYLE NANA, new species.**

Fig. 30.

1920. *Ascocotyle nana* RANSOM, 1920 (the present paper), (in *Vulpes lagopus*; U. S.).

*Specific diagnosis*.—*Ascocotyle*: Length, 0.61 to 0.79 mm.; maximum width, 0.275 to 0.38 mm.; outline of body piriform. Cutaneous scales about 4  $\mu$  long by 2  $\mu$  wide. Circumoral spines 16 to 20 in number, 8 to 12  $\mu$  long, dorsally arranged in a double row, ventrally in a single row. Dorsal lip short, rounded, not triangular in outline. Oral sucker 35 to 45  $\mu$  wide, 40 to 50  $\mu$  long, with a small hollow oral cecum 30 to 60  $\mu$  long, 8 to 12  $\mu$  wide, terminating in a point posteriorly. Pharynx globular or cylindrical, 32 to 40  $\mu$  wide, 32

to  $45\mu$  long, located 125 to  $185\mu$  from the anterior end of the body, 40 to  $100\mu$  in front of the bifurcation of the intestine. Intestinal ceca extend some distance posterior of the level of ventral sucker, posterior ends hidden by the coils of the uterus. Ventral sucker  $365$  to  $465\mu$  from the anterior end of the body,  $45$  to  $70\mu$  in diameter. In relation with the genital sinus on the left of the median line in front of the ventral sucker a lenticular muscular body,  $40$  to  $45\mu$  wide and about  $16\mu$  long. Testes globular or oval,  $70$  to  $120\mu$  wide by  $55$  to  $100\mu$  long. Seminal receptacle median, dorsal, just in front of testes. Ovary globular or oval, ventral, just in front of right testis,  $55$  to  $80\mu$  wide,  $50$  to  $100\mu$  long. Vitellaria ventral and lateral in position, in the zone occupied by the ovary and testes, not extending forward beyond the level of the anterior border of the ovary, and consisting of five or six relatively large lobules on each side of the body. Transverse vitelline ducts in the neighborhood of the boundary between the ovarian and testicular zones. Uterus a mass of coils filling up most of the body between the testes and ventral sucker, concealing the posterior ends of the intestinal ceca. Eggs  $18$  to  $24\mu$  long,  $10$  to  $16\mu$  wide.

*Host*.—Alaskan fox (*Vulpes lagopus*).

*Location*.—Intestine.

*Locality collected*.—Washington, District of Columbia (National Zoological Park).

*Type specimens*.—United States National Museum Helminthological Collections No. 19030, collected by H. W. Graybill, May 2, 1906.

*A. nana* is very similar in appearance and in many of its structural details to *Pygidiopsis genata* Looss, 1907, found in *Pelecanus onocrotalus*, at Cairo, Egypt. *P. genata*, however, is somewhat smaller ( $0.3$  to  $0.4$ , or if expanded, nearly  $0.5$  mm. in length), and no circumoral crown of spines or oral cecum is present. Apparently, also, *P. genata* is much more deeply concave on its ventral surface than *A. nana*. Otherwise the characters of *P. genata* including the presence of a lenticular organ on the left side of the genital sinus, distribution of the vitellaria, size of the eggs, etc., correspond almost exactly to those of *A. nana*. As Looss (1907, p. 490) remarks, *Pygidiopsis* is evidently very closely related to *Ascocotyle*. The great similarity of *P. genata* (the only and type species of *Pygidiopsis*) to *Ascocotyle nana* lends additional weight to Looss's remark as to the relationship of *Pygidiopsis*.

The type specimens of *A. nana* were taken from the intestine of the same fox that harbored the type specimens of *A. longa*.

It is possible that *A. nana* may be the same as the form very imperfectly described as *A. italica* by Alessandrini (1906), who collected it from a dog in Italy. *A. italica*, like *A. nana*, has a very small oral cecum, and apparently has a similar dorsal lip, similar



intestinal ceca, a similar distribution of the vitellaria and a similar uterus, but inasmuch as Alessandrini states that *A. italica* is similar to Looss's species, *A. minuta*, except for certain differences that he names, it must be presumed that *A. nana* is distinct from *A. italica* in view of the fact that it presents differences from *A. minuta* not mentioned by Alessandrini.

Genus PYGIDIOPSIS Looss, 1907.

*Generic diagnosis*.—Heterophyidae: Lateral borders greatly curved ventralwards. Prepharynx long, about equal in length to the esophagus. Bifurcation of the intestine nearer to the ventral sucker than to the oral sucker. Intestinal ceca extend into the posterior portion of body a considerable distance beyond the level of the ventral sucker, but not as far as the testes. Genital sinus median, immediately in front of the ventral sucker. A lenticular-shaped body about half as large as the ventral sucker in relation with the terminal portion of the vas deferens and the left half of the genital sinus and protrusible through the genital pore. Prostatic portion of vas deferens weakly developed. Seminal vesicle S-shaped. Testes oval, side by side, near posterior end of body. Ovary globular, in front of right testis near the ventral surface of the body. Seminal receptacle large, globular, median, anterior of testes, near the dorsal surface of the body. Vitellaria in lateral fields, ventral in location, near posterior end of body, consisting of a few relatively large lobules, limited to the region between the levels of the anterior border of the ovary and the posterior borders of the testes. Transverse vitelline ducts meet in median line ventral of seminal receptacle. Uterus occupies most of posterior portion of body behind the genital pore as far back as the testes. Vagina opens into the right half of the genital sinus. Eggs about 20  $\mu$  long.

*Type species*.—*Pygidiopsis genata* Looss, 1907.

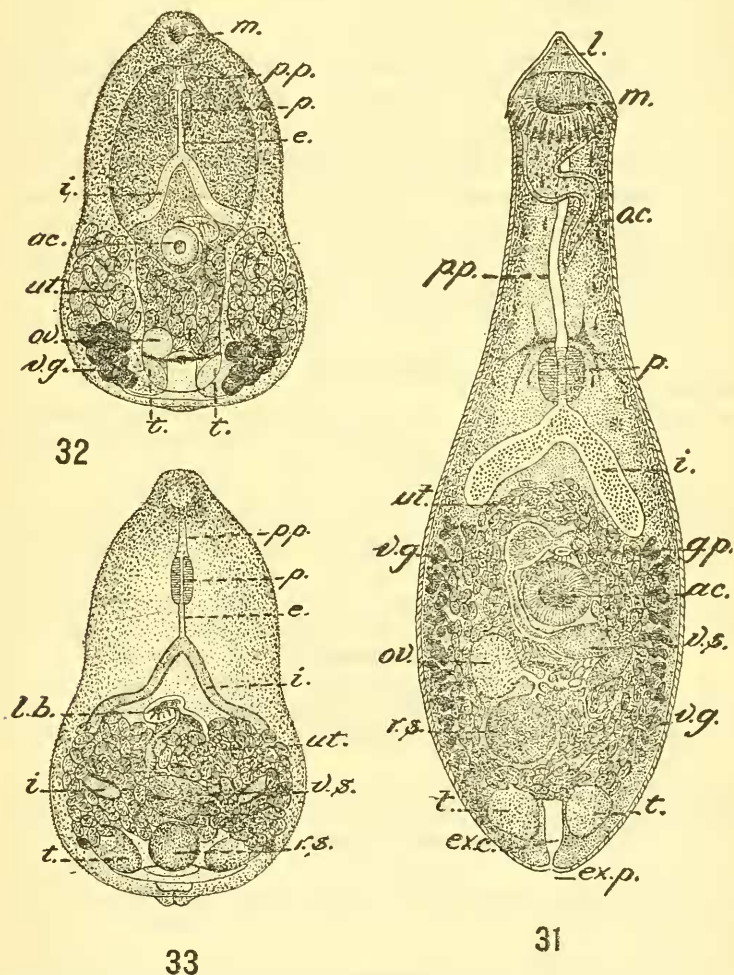
PYGIDIOPSIS GENATA Looss, 1907.

Figs. 32, 33.

1907. *Pygidiopsis genata* Looss, 1907, pp. 488-490, fig. 7 (type of *Pygidiopsis*; in *Pelecanus onocrotalus*; Egypt).

*Specific diagnosis*.—*Pygidiopsis*: Length may be nearly 0.5 mm., usually 0.3 to 0.4 mm.; maximum width, 0.2 to 0.22 mm. Lateral edges of body much curved ventralwards. Oral sucker about 40  $\mu$  in diameter. Prepharynx long. Pharynx, 36  $\mu$  long by 24  $\mu$  wide, about midway between the oral sucker and the bifurcation of the intestine. Intestinal ceca terminate about midway between the level of the ventral sucker and the level of the testes, turning toward the median line and dorsalwards near their termination. Ventral sucker 37 to 39  $\mu$  in diameter. Genital sinus immediately in front of the

ventral sucker, forming a rather deep transversely elongated cavity, into the right side of which the vagina opens. A lenticular-shaped body about half the size of the ventral sucker in relation with the terminal portion of the vas deferens, which empties into the left side of the genital sinus, this body being protrusible through the genital



FIGS. 31-33. 31.—*ASCOCOTYLE COLEOSTOMA*. VENTRAL VIEW (THROUGH ERROR THE ORAL CECUM IS SHOWN ON THE VENTRAL INSTEAD OF THE DORSAL SIDE OF THE PREPHARYNX).  $\times 128$ . AFTER LOOSS, 1896. 32.—*PYGIDIOPSIS GENATA*. VENTRAL VIEW.  $\times$  ABOUT 150. AFTER LOOSS, 1907. 33.—*PYGIDIOPSIS GENATA*. DORSAL VIEW.  $\times$  ABOUT 150. AFTER LOOSS, 1907. [FOR EXPLANATION OF LETTERING SEE FOOTNOTE, P. 532.]

pore. Prostatic portion of vas deferens weakly developed. Seminal vesicle S-shaped, the two posterior loops only ordinarily being visible as a U-shaped structure in the median line near the dorsal surface of the body behind the ventral sucker. Coils of uterus fill most of the posterior portion of the body behind the level of the ventral sucker

back to the anterior borders of the ovary and vitellaria, dorsally covering all the organs in this portion of the body, except the seminal receptacle, seminal vesicle, and ends of the intestinal ceca. Eggs light brown, thin-shelled, averaging 21 by 11  $\mu$  in diameter.

*Host*.—*Pelecanus onocrotalus*.

*Location*.—Intestine.

*Locality collected*.—Cairo, Egypt.

As Looss (1907, p. 490) remarks, this species is very closely allied to the genus *Ascocotyle*. It is especially like *Ascocotyle nana* elsewhere described in this paper, and although it is of somewhat smaller size it could scarcely be distinguished from the latter, were it not that oral spines and oral cecum are absent in *P. genata* and present in *Ascocotyle nana*. If *P. genata* should be shown to possess an oral cecum, even though it were very small and rudimentary, and if circumoral spines, which might be small and easily lost, should be discovered, this species would then undoubtedly fall into *Ascocotyle*.

#### BIBLIOGRAPHY.

ALESSANDRINI, G.

1906. Su di una specie del gen. *Ascocotyle* Lss. rinvenuta parassita del cane. Nota preventiva. Boll. Soc. zool. ital., Roma, vol. 15, ser. 2, vol. 7, 12 agosto, pp. 221-224.

BRAUN, MAX.

- 1901e. Zur Kenntniss der Trematoden der Säugethiere. Zool. Jahrb., Jena, Abt. f. Syst., vol. 14, 18 März, pp. 311-348, pls. 19-20, figs. 1-17.

CIUREA, J.

1915. Ueber einige neue Distomen aus dem Darm unserer Haustiere und des Pelikans, für welche die Fische als Infektionsquelle zu betrachten sind. Ztschr. f. Infektionskr. . . d. Haustiere, Berl., vol. 16, 1. Juni, pp. 445-458, figs. 1-3, pl. 1, figs. 1-4.

1915. Nachtrag zu meiner Arbeit: "Ueber einige neue Distomen aus dem Darne unserer Haustiere und des Pelikans" usw. Idem, vol. 17, 17 Aug., pp. 108-112.

COBBOLD, THOMAS SPENCER.

- 1866a. Tapeworms (human entozoa), their sources, nature, and treatment. vi+83 pp., 15 figs. 12<sup>mo</sup>. London.

CREPLIN, F. C. H.

- 1825a. Observationes de entozoïs. x+86 pp., 1 pl., 17 figs. octavo. Gryphiswaldiae.

DIESING, K. M.

- 1855c. Neunzehn Arten von Trematoden. Denkschr. d. k. Akad. d. Wissensch., Wien, math.-naturw. Cl., vol. 10, Abt. 1, pp. 59-70, pls. 1-3.

FISCHÖEDER, FRANZ.

- 1903h. Die Paramphistomiden der Säugethiere. Zool. Jahrb., Jena, Abt. f. Syst., vol. 17, 9 Feb., pp. 485-660, figs. A-Q, pls. 20-31, figs. 1-104.

JÄGERSKIÖLD, L. A.

- 1899a. *Distomum lingua* Creplin, ein Genitalnapftragendes *Distomum*. Bergens Mus. Aarb. (1898), Hefte 2, pp. 1-16, 1 pl., figs. 1-4.

- 1903a. *Scaphanocephalus expansus* (Crepl.), eine genitalnapftragende Distomide. 16 pp., 3 figs., 1 pl., 5 figs. octavo. Upsala. (Results of the Swedish Zool. Expedition to Egypt and the White Nile, 1901 (23).)

## KATSURADA, F.

1913. [*Metagonimus yokogawai*.] Centralbl. f. Bakteriöl. [etc.], Jena, Abt. 1, vol. 72, 16 Dec., Orig., p. 173.
1914. Studien über Trematodenlarven bei Süsswasserfischen, mit besonderer Berücksichtigung der Elb- und Alsterfische. Vorläufige Mitteilung. Idem, Abt. 1, vol. 73, 30 März, Orig., pp. 304-314, figs. 1-14.

## LEIPER, ROBERT T.

1913. Observations on certain helminths of man. Tr. Soc. Trop. M. & Hyg., Lond. (1912-13), vol. 6, July, pp. 265-297, figs. 1-36.
1913. Seven helminthological notes. J. London School Trop. M., vol. 2, Nov., pp. 175-178, 1 fig.

## LINTON, EDWIN.

- 1900a. Fish parasites collected at Woods Hole in 1898. pp. 267-304, pls. 33-43, 121 figs. quarto. Washington. (Advance separate from Bull. U. S. Fish Comm. (1899), vol. 19.)
- 1901b. Parasites of fishes of the Woods Hole region. pp. 405-492, 34 pls., 379 figs. quarto. Washington. (Advance separate from Bull. U. S. Fish Comm. (1899), vol. 19.)
1915. *Tocotrema lingua* (Creplin) the adult stage of a skin parasite of the cunner and other fishes of the Woods Hole region. J. Parasitol., Urbana, Ill., vol. 1, Mar., pp. 128-134, figs. 1-3. [Issued Mar. 22.]

## LOOSS, ARTHUR.

- 1894d. Ueber den Bau von *Distomum heterophyes* v. Sieb. und *Distomum fraternum* n. sp. 59 pp., 2 pls. octavo. Cassell.
- 1896b. Recherches sur la faune parasitaire de l'Egypte. Première partie. Mem. de l'Inst. égypt., Le Caire, vol. 3, pp. 12-252, pls. 1-16, figs. 1-193.
- 1899b. Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens, zugleich Versuch einer natürlichen Gliederung des Genus *Distomum* Retzius. Zool. Jahrb., Jena, Abt. f. Syst., vol. 12, 28 Dec., pp. 521-784, figs. a-b, pls. 24-32, figs. 1-90.
- 1902m. Ueber neue und bekannte Trematoden aus Seeschildkröten. Nebst Erörterungen zur Systematik und Nomenclatur. Zool. Jahrb., Jena, Abt. f. Syst., vol. 16, 24 Nov., pp. 411-894, figs. A-B, pls. 21-32, figs. 1-181.
- 1902n. Eine Revision der Fasciolidengattung *Heterophyes* Cobb. (Notizen zur Helminthologie Aegyptens, 5.) Centralbl. f. Bakteriöl. [etc.], Jena, Abt. 1, vol. 32, 29 Nov., Orig., pp. 886-891.
1907. Notizen zur Helminthologie Aegyptens. 7. Ueber einige neue Trematoden der ägyptischen Fauna. Idem, Abt. 1, vol. 43, 5 März, Orig., pp. 478-490, figs. 1-7.

## LUEHR, MAX.

- 1899k. Zur Kenntnis einiger Distomen. Zool. Anz., Leipz., vol. 22, 28 Dec., pp. 524-539.
1909. Parasitische Plattwürmer. 1. Trematodes. Süsswasserfauna Deutschlands (Brauer), Jena, Heft 17, iv+217 pp., 188 figs.

## MOQUIN-TANDON, ALFRED.

- 1860a. Éléments de zoologie médicale, contenant la description détaillée des animaux utiles à la médecine et des espèces nuisibles à l'homme, particulièrement des venimeuses et des parasites, précédée de considérations générales sur l'organisation et sur la classification des animaux et d'un résumé sur l'histoire naturelle de l'homme. xvi+428 pp., 122 figs. 12<sup>mo</sup>. Paris.



## MUEHLING, PAUL.

1898a. Studien aus Ostpreussens Helminthenfauna. Vorläufige Mittheilung. Zool. Anz., Leipz., vol. 21, 10 Jan., pp. 16-24.

1898b. Die Helminthen-Fauna der Wirbeltiere Ostpreussens. Arch. f. Naturg., Berl., 64. Jahr., vol. 1, Mai, pp. 1-118, pls. 1-4, figs. 1-28.

## NICOLL, WILLIAM.

1907f. Observations on the trematode parasites of British birds. Ann. & Mag. Nat. Hist., Lond., ser. 7, vol. 20, Sept., pp. 245-271.

1909. Studies on the structure and classification of the digenetic trematodes. Quart. J. Micr. Sci., Lond., n. s., vol. 53, May, pp. 391-487, pls. 9-10, figs. 1-28.

## ODHNER, T.

1914. Die Verwandtschaftsbeziehungen der Trematodengattung *Paragonimus* Brn. Zool. Bidrag, Uppsala & Stockholm, vol. 3, pp. 231-246, figs. 1-5.

## OLSSON, PETER.

1876b. Bidrag till skandinaviens helminthfauna. 1. K. Svenska Vetensk.-Akad. Handl., Stockholm (1875), new ser., vol. 14, Art. 1, 35 pp., pls. 1-4, figs. 1-71.

## RAILLIET, ALCIDE.

1890c. Les parasites des animaux domestiques au Japon. Naturaliste, Par., an. 12, ser. 2, vol. 4, 15 juin, pp. 142-143.

## RANSOM, B. H.

1920. Synopsis of the trematode family Heterophyidae with descriptions of a new genus and five new species. Proc. U. S. Nat. Mus., vol. 57, pp. 527-573.

## RYDER, JOHN A.

1884a. On a skin parasite of the cunner (*Otenolabrus adspersus*). Bull. 4, U. S. Fish Comm., Wash., pp. 37-42.

## VON SIEBOLD, CARL THEODOR ERNST.

1852f. Ein Beitrag zur Helminthographia humana, aus brieflichen Mittheilungen des Dr. Bilharz in Cairo, nebst Bemerkungen. Ztsch. f. wissensch. Zool., Leipz., vol. 4, 15 Juni, pp. 53-76, pl. 5, figs. 1-20.

## STAFFORD, JOSEPH.

1905a. Trematodes from Canadian vertebrates. Zool. Anz., Leipz., vol. 28, 11 Apr., pp. 681-694.

## STILES, CH. W.; and HASSALL, ALBERT.

1900a. A muscle fluke (*Agamodistomum* sp.) in American swine (pp. 559-560, fig. 23); the lung fluke (*Paragonimus westermanii*) in swine and its relation to parasitic haemoptysis in man (pp. 560-611, pls. 23-24, figs. 24-28); the conical fluke (*Amphistoma cervi*) of cattle slaughtered in the United States (p. 611, 1 fig.). (Notes on parasites, 50-52). 16. Ann. Rep. Bureau of Animal Indus., U. S. Dept. Agric., Wash. (1899), Dec. 31, pages and figs. cited.

## STOSSICH, MICHELE.

1892c. I distomi degli uccelli. Lavoro monografico. Boll. Soc. adriat. di sc. nat. in Trieste, vol. 13, pp. 143-196.

1899c. La sezione degli echinostomi. Idem. vol. 19, mem., pp. 11-16 (6 pp.).

## TRAVASSOS, LAURO.

1916. Informaçõs sobre a fauna helminthologica sul-fluminense. Brazil-med., Rio de Jan., vol. 30, 1 jan., pp. 1-2.

WEINLAND, DAVID FRIEDRICH.

- 1858a. Human cestoides. An essay on the tapeworms of man, giving a full account of their nature, organization, and embryonic development; the pathological symptoms they produce, and the remedies which have proved successful in modern practice. To which is added an appendix, containing a catalogue of all species of helminthes hitherto found in man. x+93 pp., 12 figs. octavo. Cambridge [Mass.].

WIGDOR, MEYER.

1918. A new fluke from the dog. Journ. Amer. Vet. M. Ass., Baton Rouge, La., vol. 54 (new ser., vol. 7), Dec., pp. 254-257, figs. 1-4.

YOKOGAWA, SADAMU.

1913. Ein neuer Saugwurm, welcher *Plecoglossus altivelis* zum Zwischenwirt nimmt, *Metagonimus yokogawai*. [Japanese text.] Mitt. d. med. Gesellsch. zu Tokio, vol. 27, 5 Mai, pp. 49-77, 1 pl., figs. 1-15; summary in German, pp. 3-4, by N. Takahashi.
1913. Ueber einen neuen Parasiten, *Metagonimus yokogawai*, der die Forellenart *Plecoglossus altivelis* (Temminck) zum Zwischenwirt hat. Bildung einer neuen Gattung. Centralbl. f. Bakteriologie. [etc.], Jena, Abt. 1, vol. 72, 16 Dec., Orig., pp. 158-179, pls. 1-3, figs. 1-17. [MS. dated Juni.]
1913. Ueber eine neue Species *Metagonimus*—*M. oratus*. [Japanese text.] Mitt. d. med. Gesellsch. zu Tokio, vol. 27, 5 Nov., pp. 45-49, 1 pl., figs. 1-2; summary in German, pp. 3-4, by G. Osawa.